PB85-111193

Nationwide Urban Runoff Program Study for Eugene and Springfield, Oregon

Lane Council of Governments, Eugene, OR

Prepared for

Environmental Protection Agency, Washington, DC
Water Planning Div

Jun 82

U.S. Department of Commerce
National Technical Information Service
NTIS

PB85-111193

LCOG Lane Council of Governments

208 WASTE WATER MANAGEMENT

Nationwide Urban Runoff Program Study for Eugene and Springfield, Oregon

FINAL REPORT

June, 1982

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

50272-101

REPORT DOCUMENTATION PAGE

1. REPORT NO.

2.

3. Recipient's Accession No. PB85 111193

4. Title and Subtitle
Nationwide Urban Runoff Program, Study for Eugene and Springfield, Oregon, FINAL REPORT.

5. Report Date JUNE, 1982

6.

7. Author(s)
gerritt Rosenthal and Rebecca A. Kreag

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Lane Council of Governments
Public Service Building
125 Eighth Avenue East
Eugene, Oregon 97401

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G) P-000157-011

12. Sponsoring Organization Name and Address
EPA, Office of Water Program Operations
Water Planning Division
401 M Street, SW
Washington, D C 20460

13. Type of Report & Period Covered
Final, 1978-1982

14.

15. Supplementary Notes
(Oregon)

Reproduced from best available copy.

16. Abstract (Limit: 200 words)

This document was developed to summarize the results of monitoring and data inventories, pilot study conclusions and special impact assessments; to evaluate overall loadings and impacts of urban runoff on receiving waters, special concern areas, and beneficial water uses; to integrate the results from current studies into past study efforts and needs assessments; to outline an overall urban runoff management plan for the cities of Eugene and Springfield, incorporating financial management information specifically; to evaluate the potential for urban runoff management for other urban areas within the Lane COG planning area; and to provide a basis for input by local jurisdictions on appropriate elements of State and Federal nonpoint source control policy.

17. Document Analysis a. Descriptors

Hydrology
Urban development
Watersheds
Water pollution
Water resources
Sedimentation
Storms
Regional planning
Urban planning
Civil Engineering

b. Identifiers/Open-Ended Terms

Runoff
Streamflow
Stream pollution
Rainfall
Snowmelt
Soil Erosion
Water Quality
Sediments
Sediment Transport
Suspended Solids
Storm Drains
Urbanization
Land use

c. COSATI Field/Group

18. Availability Statement: No restriction on distribution. Available from National Technical Information Service, Springfield, VA 22161

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 455

22. Price

(See ANSI-Z39.18)

See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

NATIONWIDE URBAN RUNOFF PROGRAM STUDY FOR EUGENE AND SPRINGFIELD, OREGON

FINAL REPORT

Gerritt Rosenthal
and
Rebecca A. Kreag

Lane Council of Governments
208 Water Quality Program

June 1982

i.a

DISCLAIMER

Although the research described herein has been funded in part by the U.S. Environmental Protection Agency, through Grant #P-000157-011, to the Lane Council of Governments, it has not been subject to the agency's peer or administrative review and therefore, does not necessarily reflect the views of the agency, and no official endorsement should be inferred.

TABLE OF CONTENTS

PAGE

DISCLAIMER ii

ACKNOWLEDGMENT iii

LIST OF TABLES vii

LIST OF FIGURES ix

I. INTRODUCTION
- Purpose of Report 1
- History of L-COG Urban Runoff Planning 1
- General Program Goals 2
- Specific Study Objectives 3

II. STUDY AREA
- General Description 6
- Drainage Basin Study Areas 9

III. DATA BASE
- Rainfall 30
- Flow and Discharge 34
- Water Quality 36
- Background Water Quality Evaluation 51

IV. MODELING
- Goals and Application 60
- Model Review and Selection 61
- Modeling Activity and Results 62
- Future Work 62

V. MANAGEMENT PILOT STUDIES
- Vegetation Management (Summary) 64
- Sediment Retention (Summary) 65
- Street Sweeping (Summary) 67
- Straw Bale Oil Trap 69

VI. FINANCIAL MANAGEMENT/IMPLEMENTATION
- Objectives 79
- Ordinance Review 79
- Financial Evaluation of BMP's 81
- Consultant Activity 82
- Results 82
- Implementation 87

VII. PUBLIC INVOLVEMENT

Urban Runoff Workshop 88
Summary of 208 Areawide Committee Activities 89

VIII. IMPACT ASSESSMENT

Social Impacts 94
Economic Impacts 96
Environmental Impacts 97
Overall Assessment 99

IX. EXECUTIVE SUMMARY

Overview 100
Study Objectives - Results Achieved 102
Work Task Outputs 106
Call for Action 111

REFERENCES 117

APPENDICES

Appendix A - Rainfall Data
Appendix B - Flow Data
Appendix C - Water Quality Data
Appendix D - Modeling
Appendix E - Pilot Study Recommendations
Appendix F - Ordinances and Implementation
Appendix G - Public Involvement
Appendix H - Management Program
Appendix I - Annotated Bibliography

ACKNOWLEDGMENT

This study was completed with the active participation of Eugene, Springfield, and Lane County staff including:

CITY OF EUGENE - Public Works

Don Allen
Donald Gillman
Kenneth Hatch
William Guenzler
Bert Teitzel
Ray Anderson
Douglas Cook
George Jessie
Brian Shelton
Michael Wilson
Terry Smith
Paul McNamara
William Gurley

CITY OF SPRINGFIELD - Public Works

Michael Kelley
Daniel Brown
Edward Black
Dave Boyington
John Thomas
Cliff Scott
Don Rogers
Ken Vanderford
Henry Mackenroth
Ray Spencer

LANE COUNTY - Building and Sanitation - Water Laboratory

John Stoner
Harry Youngquist
Kay Percy
James Ollerenshaw

In addition, contributions were made by the following consultants:

Jack Markowski
Chinook Research Laboratories
Kramer, Chin and Mayo, Inc.
David Dornbusch and Co., Inc.
CH2M/Hill
U.S. Geological Survey

We would also like to note the assistance of the following personnel from the Oregon Department of Environmental Quality and the Region X, Environmental Protection Agency which provided project and policy review, data management assistance and other important coordination tasks:

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

Neil Mullane
Andy Schaedel

REGION X, U.S. ENVIRONMENTAL PROTECTION AGENCY

John Underwood
Bill Clothier
Debbie Yamamoto
Lisa Corbyn
Ray Peterson
Bruce Cleland

Finally, we appreciate the coordination and technical assistance of the EPA NURP staff in Washington and the NURP consultant team.

REPORT PREPARED BY
LANE COUNCIL OF GOVERNMENTS

George Kloeppel, Executive Director

with

Jim Carlson
Gary Darnielle
Jennifer Fairbanks

Paul Hargraves
Carol Hughes

Cress Bates
Barbara Phillips

LIST OF TABLES

PAGE

TABLE 1: Climatological Summary for Eugene, Oregon 8

TABLE 2: Beneficial Use Matrix for Eugene/Springfield Waterway and Drainage Systems 10

TABLE 3: Eugene/Springfield Urban Runoff Drainage Basin Characteristics and Problems 11

TABLE 4: Upper Amazon Monitoring Station Land Use Characteristics 22

TABLE 5: Lower Amazon and Polk Street Stormsewer Land Use Characteristics 23

TABLE 6: Q Street Land Use Characteristics 24

TABLE 7: Typical Winter Monthly Rainfall Record, Eugene Airport 32

TABLE 8: Dryfall-Wetfall Data 35

TABLE 9: Water Quality Site Summary 42

TABLE 10: Priority Pollutant Catchments - Land Use Distribution 45

TABLE 11: Priority Pollutant Catchments - Physiographic Characteristics 46

TABLE 12: Priority Pollutant Catchments - Soils Data 47

TABLE 13: Priority Pollutants Detected in Eugene Storm Runoff 50

TABLE 14: Amazon Creek and West Eugene Channels Water Quality - Linear Comparisons (Same Date) 52

TABLE 15: A-3 Channel Above and Below Bertelsen Slough (Background Conditions - 1978-1981; Same Date) 53

TABLE 16: Q Street Channel Water Quality - Linear Comparison for Non-Storm Conditions - 1976-1978 (Same Date) 54

TABLE 17: Q Street Channel Water Quality - Linear Comparison - 1979-1981 (Same Date) 55

TABLE 18: Willamette River and Polk Stormsewer Water Quality - Linear Comparison - 1979-1981 (Same Dates - Non-Storm) 56

TABLE 19: Worst Parameter Values 59

TABLE 20: Oil Trap Pilot Study - Water Quality Data 75

LIST OF TABLES (Continued)

		PAGE
TABLE 21:	Oil Trap Pilot Study - Straw Bale Trap Costs	77
TABLE 4.1E:	Potential Water Quality Enhancement Activity (Eugene)	83
TABLE 4.1S:	Potential Water Quality Enhancement Activity (Springfield)	84
TABLE 22:	Revenue Requirement (1981-82 Fiscal Year- Springfield)	85

LIST OF FIGURES

PAGE

FIGURE 1: NURP Study Area Location Map 7

FIGURE 2: Upper Amazon Monitoring Sites 25

FIGURE 3: Other Eugene Basins and Monitoring Stations 26

FIGURE 4: "Q" Street Channel Basin Monitoring Sites 27

FIGURE 5: Effect of Differing "Interevent" Times on SYNOP Average Storm Statistics 31

FIGURE 6: Rainfall and Amazon Channel Runoff - January 12-15, 1981 37

FIGURE 7: Rainfall and Amazon Channel Runoff - March 10-12 and May 9-10, 1980 38

FIGURE 8: Rainfall and Amazon Channel Runoff - June 23-25, September 9-10 and October 11-14, 1980 39

FIGURE 9: Rainfall and Amazon Channel Runoff - October 25-27 and November 21-23, 1980 39

FIGURE 10: Rainfall and Amazon Channel Runoff - December 1-6, 1980 39

FIGURE 11: Priority Pollutant Sampling: Rainfall, Runoff and Sampling Times - May 5, 1981 48

FIGURE 12: Priority Pollutant Sampling: Rainfall, Runoff and Sampling Times - October 27-28, 1981 49

FIGURE 13: Straw Bale Oil Trap (Structure) 71

FIGURE 13: Straw Bale Oil Trap (Site Sketch) 72

SECTION I

INTRODUCTION

PURPOSE OF REPORT

This report on the Lane Council of Governments (L-COG) 208 Nationwide Urban Runoff Program (NURP) will satisfy several important functions which are herewith listed, not in order of priority:

- Satisfy U.S. Environmental Protection Agency (EPA) grant requirements for NURP Grant #P-000157-011 to the Lane Council of Governments -- Milestone #9 "URO Summary Report;"
- Summarize the results of monitoring and data inventories, pilot study conclusions and special impact assessments;
- Integrate the results from current studies into past study efforts and needs assessments;
- Evaluate overall loadings and impacts of urban runoff on receiving waters, special concern areas, and beneficial water uses;
- Outline an overall urban runoff management plan for the cities of Eugene and Springfield, incorporating financial management information specifically;
- Evaluate the potential for urban runoff management for other urban areas within the L-COG planning area;
- Provide a data base and supporting information to the EPA NURP report groups; and
- Provide a basis for input by local jurisdictions on appropriate elements of State and Federal non-point source control policy.

HISTORY OF L-COG URBAN RUNOFF PLANNING

In 1975, L-COG received Areawide 208 Wastewater planning designation from the State of Oregon. In the same year, L-COG received a Section 208 Planning Grant from the EPA, which included the identification of urban runoff management needs as a significant work task. This first-phase effort produced several reports:

- "Urban Stormwater Analysis -- Eugene Springfield Area," by Jordan/Avent and Associates (1977)

  This report used limited monitoring data to calibrate a model for storm runoff and predict pollution loads to the area's streams. The report identified major storm receiving areas and indicated that non-point source loads could be significant compared to other pollution sources.

- "Lane County -- Upper Willamette River Basin Industrial Wastes Survey," by L-COG (1978)

  This report surveyed industrial sites and discharges throughout Lane County but especially in the Eugene-Springfield area. The report concluded that industrial discharge permits were of less concern than industrial non-point runoff sources.

- "Urban Storm Runoff Management Study -- Summary Report," by L-COG (1977)

  This study summarized the characteristics and beneficial uses of major urban runoff channels in the Eugene-Springfield area. The report indicated possible areas of management improvement and detailed further study needs.

In a demonstration of concern over the urban runoff situation, local jurisdictions provided program support in 1978, which resulted in a short "Urban Runoff Executive Summary" (1978) and a grant request for a second-phase urban runoff management and implementation effort. The Executive Summary identified specific work needs that were elaborated in the grant request.

In February 1978, an initial EPA grant award was made to pursue local urban runoff management implementation. This grant was expanded in July 1979 to include NURP program goals, which covered both local implementation and process identification, as well as national pilot study and quality data needs.

The current report is a culmination of this effort from the planning and data generation standpoint, although efforts at local implementation are expected to continue for some time, dependent on budgetary processes and local needs.

GENERAL PROGRAM GOALS

As defined in the NURP grant proposal, the general goals of the project can be listed as follows:

1. Identification and refinement of urban runoff best management practices for local implementation and national comparison

   Identification was pursued through data collection and beneficial use impact evaluation. Refinement of techniques was pursued through investigation of pilot studies.

2. Identification of financial options for urban runoff control program implementation

   A consultant study detailed current costs and proposed allocations, and proposed a method of financing of specific activities.

3. Refinement of information on the quality of urban runoff during storm conditions with the identification of impacts on beneficial uses or on specific receiving waters

   Both general and special purpose monitoring efforts provided data on a wide variety of pollutants. Special studies looked at biological impacts.

4. Expansion of the national urban runoff non-point pollution data base, in regard to runoff quality and sources, as well as storm characteristics

   Data collected in the field was transferred to the STORET Data System.

5. Evaluation of methods of implementation of urban runoff controls, along with an evaluation of the economic and social costs and benefits of such programs

   A financial management study detailed current and projected costs and evaluated equitable means of cost allocation. The Areawide Advisory Committee participated in prioritizing beneficial uses and identifying major social goals.

6. Expansion of the storm modeling capacity of Eugene and Springfield

   Several models were evaluated and assistance was provided on data entry and model calibration.

7. Participation in the National Priority Pollutant Survey, accomplished through a special sampling program

8. Outlining of policies and actions necessary on the part of local and state agencies to control and prevent urban non-point pollution

   Specific recommendations on programs and policies have been and will continue to be lobbied for before local agencies and the Oregon Department of Environmental Quality (DEQ).

SPECIFIC STUDY OBJECTIVES

In addition to general programmatic goals, the L-COG NURP study has specific study goals with regard to local data and information needs. Although the data has a wide range of specific and general uses, the following are the more important of these:

1. Evaluate available models for urban runoff, specifically including the CH2M/Hill, Stormwater Analysis Model (SAM) available to the City of Eugene

2. Encourage Eugene and Springfield to establish a systematic urban runoff management system, utilizing a computerized data base

3. Increase the local rainfall data base in order to estimate areal variations in duration/intensity in various locations

4. Evaluate the characteristic storm frequencies and intensities (including inter-storm periods), using the SYNOP Rainfall Analysis Program

5. Identify, map and describe the pertinent runoff and runoff pollution features for the major storm basins in the Eugene-Springfield area

6. Identify major areas and types of beneficial uses that are dependent on or affected by urban runoff

7. Identify receiving waters of special protection concern and develop protection plans for these areas

8. Collect additional storm and background water quality data for the major storm channels in Eugene and Springfield (among other things, this data is to be used to define storm/background variations and help refine BMP's)

9. Evaluate the quality impacts and practical aspects of small-to-medium size sediment control basins on major storm channels

10. Provide some guidelines for location, construction and maintenance of sediment control basins

11. Evaluate the potential benefits and techniques of in-channel vegetation management (specifically cattails, Typha latifolia) on the Amazon Channel

12. Evaluate the water quality impacts of natural "in-channel" vegetation as it occurs in local channels

13. Characterize the biological systems of the Amazon Channel and correlate their indices with known water quality conditions (if possible, use this characterization to define impacts of runoff pollution)

14. Investigate specific methods of industrial site runoff control, particularly regarding oil and grease trapping

15. Develop industrial site management guidelines and ordinances

16. Evaluate hillside erosion and erosion control methods in Eugene and Springfield

17. Propose runoff control ordinances where appropriate

18. Evaluate current street cleaning activities in the cities (in particular, test street sweeping methods at one pilot site regarding cost and efficiency)

19. Propose changes in the street program where needed

20. Evaluate financial resources and needs for urban runoff control

21. Propose a financing plan to implement urban runoff management proposals

22. Identify specific impacts of urban runoff pollution, particularly regarding existing park and recreation uses (in particular, identify the yearly loadings to Fern Ridge Reservoir, the Willamette River and Alton Baker Park from urban pollution)

23. Provide for greater public awareness and concern over runoff pollution problems, particularly regarding hazardous and toxic materials

24. Propose policies and actions for a statewide urban runoff management program

A summary of the progress achieved or directions set in regard to these goals is described in Section IX, EXECUTIVE SUMMARY. Each goal is also discussed in more detail under the specific work task. Not all goals were met equally.

SECTION II

STUDY AREA

GENERAL DESCRIPTION

Eugene and Springfield form the second largest metropolitan area in Oregon (1980 metro population 193,511). Wood products industries are a predominant feature of the economy of both cities. Eugene (1980 population 105,624) is a more diversified community, with the University of Oregon, food processing industries, significant downtown commercial district and a major regional shopping center. Springfield (1980 population 41,621) had the highest rate of growth of any major Oregon city between 1970 and 1980. Two major retail areas are found in Springfield but strip commercial development predominates along the major highways.

Both cities are situated at the southern end of the Willamette Valley (Figure 1). As a result, the terrain is a combination of very flat flood plain and valley floor, foothills in South and West Eugene and South and East Springfield, and scattered butte formations in the flood plain. Springfield is sandwiched between the middle fork of the Willamette River on the south and the McKenzie River on the north. The Interstate 5 freeway is the general separation between Springfield and Eugene. Eugene spans the main stem of the Willamette River and its southern boundary approximates the ridge line of the small Amazon Creek drainage. Both cities rely on systems of open channels and separate storm sewers for conveyance of storm runoff. Much of Springfield as well as the urban core area drains directly into the Willamette at Eugene, but urban runoff from the Amazon Creek drainage passes either through a reservoir (Fern Ridge) and major tributary (Long Tom River) or directly to the Long Tom before returning to the Willamette River, approximately 35 miles downstream (north) of Eugene.

The area has a moderate climate typical of Western Oregon and Washington. Most rain occurs from November through March, with lesser amounts in spring and fall and generally very little precipitation during summer. It rarely snows and when it does, streets are only treated with sand/gravel. Freezing temperatures generally coincide with high pressure systems lacking precipitation. Rainfall is generally gentle and only rarely exceeds 0.5 inches per hour. The winter storms are frequently of long duration (over 24 hours of near continuous rain) and several fronts follow a storm, causing precipitation to be recorded for several days in a row. Highest rainfall intensities normally occur in the middle of longer storms. Monthly temperature and rainfall data are listed in Table 1.

For the most part, Eugene and Springfield storm sewer lines are connected to small open channel drainage systems that eventually make their way into the Willamette River or its major tributaries. The one exception is the historic seven-foot interceptor sewer (Polk Street) for downtown Eugene which drains directly into the Willamette River at the end of Polk Street.

Combined storm and sanitary sewers were eliminated in the early 1970's to prevent sewage bypass into the Willamette River. Presently, many of the urban

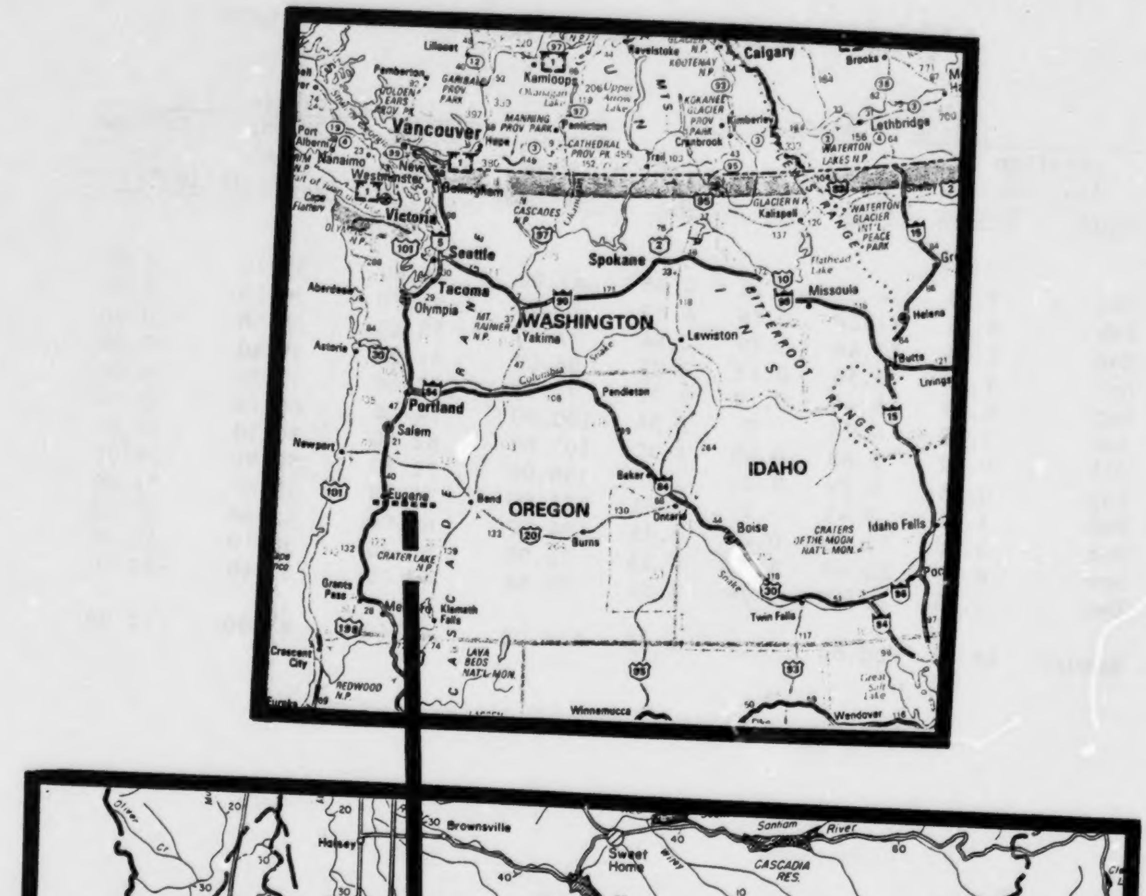

Vancouver
Victoria
Seattle
Tacoma
Olympia
Spokane
WASHINGTON
Yakima
Lewiston
Missoula
Helena
Portland
Salem
Eugene
Bend
OREGON
Pendleton
Baker
Boise
IDAHO
Idaho Falls
Twin Falls
CRATER LAKE N.P.
Medford
Klamath Falls
Winnemucca
Wendover
Calgary
Lethbridge
Kamloops
Brownsville
Sweet Home
Halsey
Harrisburg
Junction City
Coburg
SPRINGFIELD
EUGENE
FERN RIDGE RES.
CASCADIA RES.
HOLLEY RES.
Calapooia River
SMITH RES.
TRAIL BRIDGE RES.
BLUE RIVER RES.
GATE CREEK RES.
McKenzie River
STRUBE RES.
COUGAR RES.
FALL CREEK RES.
Lowell
DEXTER RES.
LOOKOUT POINT RES.
Creswell
Cottage Grove
DORENA RES.
COTTAGE GROVE
HILLS CREEK
Oakridge
Waldo Lake
L A N E
Middle Fk Willamette
SUBBASINS
1 Coast Fork
2 Middle Fork
3 McKenzie
4 Long Tom

FIGURE 1

NURP STUDY AREA LOCATION MAP

Reproduced from best available copy.

TABLE 1: CLIMATOLOGICAL SUMMARY FOR EUGENE, OREGON

	Precipitation				Temperature			
Month	Average 1943-1980 Inches	High	Low	24-Hr Max	Extreme High 1942-1980	Normal High 1941-1970	Normal Low 1941-1970	Extreme Low 1942-1980
Jan	7.83	14.83	1.11	4.88	67.00	45.60	33.10	4.00
Feb	5.11	11.58	0.86	4.17	71.00	51.70	35.20	3.00
Mar	5.04	12.46	0.79	2.44	77.00	55.20	36.50	20.00
Apr	2.66	6.56	0.52	2.25	86.00	61.20	39.40	27.00
May	1.94	4.44	0.29	2.37	91.00	67.80	43.70	28.00
Jun	1.25	4.76	T	2.36	100.00	74.10	48.70	32.00
Jul	0.32	2.63	0.00	1.39	105.00	82.60	51.10	39.00
Aug	0.85	5.79	0.00	1.89	106.00	81.30	50.90	38.00
Sep	1.41	3.45	T	1.68	101.00	76.50	47.40	32.00
Oct	3.80	12.66	0.29	3.85	94.00	64.00	42.30	19.00
Nov	6.79	20.48	1.20	4.53	76.00	53.10	38.10	12.00
Dec	7.75	20.99	1.24	4.82	68.00	47.40	35.60	-12.00
Annual	44.75	60.67	23.26	4.88	106.00	63.40	41.80	-12.00

channels are the focus of a variety of uses besides drainage, such as urban green ways, recreational corridors, fish and wild life habitat and irrigation. Public Works officials are finding that these public values can have a strong influence on what used to be a single purpose objective of moving storm water as quickly as possible from the cities. Water quality and aesthetics within these feeder streams is a concern in itself, in addition to its impact on major receiving waters. Table 2 lists the present beneficial water of each urban waterway. A summary of the characteristics and originally perceived problems and uses of each basin follows in Table 3. Five of those basins were singled out for extensive monitoring and pilot studies to test Best Management Practices (BMP): Amazon Basin (#s 5, 7, 8), Q Street Basin (#s 17-20), Eugene and Springfield Millraces (#s 15, 22) and Polk Street Storm Sewer (#28). They are described in more detail.

DRAINAGE BASIN STUDY AREAS

Study basins and monitoring sites were selected to represent channels with important primary or secondary uses or which might affect other major receiving waters. The monitoring sites generally divided basins into predominate land use categories or characteristic channel types. Eighteen baseline monitoring stations were established and six additional stations served for pilot studies. The monitoring station drainages ranged from slightly under 1 square mile to over 18 square miles. The distribution of land uses is presented in Tables 4, 5 and 6, and station locations are shown in Figures 2, 3 and 4.

Eugene

Amazon Channel/A-3/A-2--

The Amazon Basin has been separated into a lower and upper basin by a major diversion structure and channel which carries most of the runoff from the upper basin to Fern Ridge Reservoir. The upper basin is cradled by a ridge of hills to the south. Much of the recent residential construction has been located in the southern hills, and most of the developed land in the upper Amazon is residential. There were four baseline monitoring stations on the Amazon. A sediment trap pilot study was conducted at the upstream station and a vegetation management pilot study was completed at the downstream station. Three additional stations covered the pilot test sites.

The lower basin is essentially flat. Several feeder channels guide drainage to the main Amazon Creek channel. The extensive drainage system was required before this flood prone area could be developed for industrial and residential use. The lower basin contains extensive agricultural land, as well as urban areas. Two of the urbanized feeder channels, A-2 and A-3, were also focii of this program. The A-2 channel subbasin is residential and industrial. It passes through a large undeveloped borrow pond which is scheduled to become a park. A single monitoring station recorded quality entering the pond. The A-3 drainage is primarily industrial and planned industrial land. A small wildlife area, Bertelsen Slough, that A-3 passes through has been designated by Eugene for preservation. Two monitoring sites above and below the slough recorded urban runoff impacts on the marsh and vice versa. Priority pollutants were also sampled below the slough.

TABLE 2: BENEFICIAL USE MATRIX FOR EUGENE/SPRINGFIELD WATERWAYS AND DRAINAGE SYSTEMS

	Municipal Supply	Industrial Supply	Irrigation Supply	Livestock Supply	Aquifer Recharge	Fish and Wildlife	Water-Dependent Recreation	Water-Enhanced Recreation	Aesthetics	Development Enhancement	Flood Control/Drainage	Waste Assimilation/Dilution	Hydropower	NURP Runoff Monitoring
WILLAMETTE RIVER (through Metro)		M	S	S		S-F	S	M	M	M		R-S		X
LOWER AMAZON CREEK (Diversion Structure to Long Tom River)			I	I		I	I		I	I	C	L		
A-1 CHANNEL (to Lower Amazon)						I					C	C-M		
A-2 CHANNEL (to Lower Amazon)						C	C	C	C	I	I	C		X
A-3 CHANNEL (to Lower Am zon)						M		I	C	C	C	C		X
FERN RIDGE RESERVOIR			R	I		R-S	R	M	L		R			
AMAZON DIVERSION CHANNEL (Diversion Structure to Fern Ridge)			I			M	I	M			C-M	M		X
UPPER AMAZON CREEK (Above Diversion Structure)						C	I	C	C	I-C	C	C		X
WILLOW CREEK (to Upper Amazon)			I			*S					I-C	I		
FLAT CREEK (to Willamette)			I								I			
SPRING CREEK (to Willamette)						I		I	I	I				
NORTH BELTLINE FLOODWAY (Willamette)					C	M			I	I	C			
DELTA PONDS CREEK (Willamette)					C	M	M	M	I	C	I			
WILLAKENZIE FLOODWAY (Delta Ponds and Willamette Groundwater)					C	M			C	I	C			
EUGENE MILLRACE (to Willamette)						C	C	C	C-R	C-R	I	C		X
ALTON BAKER CANOEWAY AND PONDS (to Willamette)						M	M	M	M	M	I			
MAIN Q STREET CHANNEL (to Alton Baker Ponds)				I		C		C	C	I	C	C		X
NORTH SPRINGFIELD BRANCH - Q STREET CHANNEL											I	C		
SOUTH BRANCH - Q STREET CHANNEL											C	C		X
NORTH BRANCH - Q STREET CHANNEL						I		I	I	I	I	C		X
GLENWOOD SLOUGH (to Willamette)						I					I	C		
SPRINGFIELD MILLRACE (to Willamette)		C	I			I	I	M	I	I-C	I	M		X
RUSSEL CREEK (to Willamette)						I					I	I-C		
BERKSHIRE SLOUGH (to Willamette)						I					I	C		
McKENZIE RIVER (th ough Metro)	M	M	S	S	C	S-F	S	S	L	R	M	S	M	
42ND STREET DITCH (to McKenzie)		I				I					I	I		
EAST SPRINGFIELD SLOUGH (to McKenzie)						I	I				C-I	C		

KEY:

Graphic Level of Use
- I: Individuals (Urban or Rural Neighborhood)
- C: Citywide Use (Eugene or Springfield)
- M: Metropolitan Area
- L: Lane Countywide
- R: Regional (Substate)
- S: Statewide
- F: National

* Rare and Endangered Plants

TABLE 3
EUGENE/SPRINGFIELD
URBAN RUNOFF DRAINAGE BASIN CHARACTERISTICS AND PROBLEMS

1. WILLAMETTE RIVER: Coast Fork to McKenzie Confluence

Characteristics - Willamette has several riffles and rapids in this reach. Drainage basin area is about 2,000 square miles. Land uses include a mix of agriculture, urban and forest on the coast fork with mostly forest on the middle fork. Urban and agricultural uses dominate on the main stem at Eugene/Springfield and it is in the Willamette Greenway.

Data - All data good-to-excellent, 3 NURP stations

Uses - Contact and non-contact recreation (Greenway and parks); industrial water supply, fish (anadromous) and wildlife, development enhancement, aesthetics, irrigation, livestock supply, waste assimilation dilution, aquifer recharge

Problems - Coliform, water temperatures, floating materials, trash

2. LOWER AMAZON CREEK: Diversion Structure to Clear Lake

Characteristics - Natural creek bed has been channelized (widened, deepened and banks diked) to enhance drainage and flood relief; receives some flow from the upper basin through the culvert and flood spillway. Clear Lake was created by irrigation check dams in the Amazon Channel; basin land use -- agricultural (one residential subdivision at Clear Lake) except for A-1, A-2 and A-3 branches described below.

Data - Very limited quality data, no flow data

Uses - Drainage, irrigation, livestock watering, flood relief at Clear Lake, fish and wildlife, fishing, hunting, boating and aesthetics

Problems - Sediment, low flow, excess nutrients, bank damage from livestock (coliform bacteria?), polluted runoff from A-2 and A-3 channels

Impacts - Siltation reduces flood capacity, eutrophied aquatic environment and impairs boating and aesthetics

3. A-1 CHANNEL: Southern Pacific Railroad to Lower Amazon Creek Below Clear Lake

Characteristics - Major SCS drainage channel dug through low land area with some log ponds; basin land use -- Highway 99 has commercial, industrial and residential areas in upper half (to Beltline) and is predominantly agricultural and industrial below Beltline.

Data - Limited quality data, no flow data

Uses - Industrial point and non-point discharge, drainage and flood relief, ponds (wildlife and aesthetics)

Problems - Nutrients, coliform, organics and industrial spills

Impacts - Sedimentation and pollution of ponds, heavy vegetation growth, other(?)

4. A-2 CHANNEL: Bethel/Highway 99 Area to Lower Amazon Creek near Clear Lake

Characteristics - Major SCS drainage channel dug through low land area, feeds Golden Garden Ponds (Beltline Road gravel pit and future Eugene park); basin land use -- industrial, residential, and some commercial above Golden Gardens Ponds and primarily agricultural below

Data - Limited quality data and quantity, 1 NURP station above ponds

Uses - Drainage, storm runoff, bikeway, irrigation aesthetic potential and undeveloped park pond (Golden Gardens)

Problem - Nutrients, oil and grease(?), vegetation overgrowth, hazardous bikeway design, difficult channel maintenance

Impacts - Channel obstruction, fish kills and potential water quality restriction of pond use when developed, unaesthetic, bikeway requires fencing

5. A-3 CHANNEL: Seneca to Lower Amazon Creek

Characteristics - Major SCS drainage channel dug through former swampy area. Channel goes through several small natural marshes (including Bertelsen Slough which was retained for wildlife); basin land use -- zoned heavy and light industrial, and is about one-third developed

Data - Quality data good, quantity data fair, 2 NURP stations (Wallis and Bertelsen) (Priority Pollutants)

Uses - Largely industrial runoff, drainage and flood control, special fish and wildlife habitat, aesthetic potential planned

Problems - Oil and grease, organics, color, sediment, nutrients, toxic metals, low dissolved oxygen, and chemical spills

Impacts - Periodic decimation of wildlife habitat, excessive vegetation and sediment, requires maintenance, probable chronic adverse affects on fish and wildlife

6. FERN RIDGE RESERVOIR: Tributaries - Long Tom River, Coyote Creek and Amazon Diversion Channel

Characteristics - Large shallow reservoir with pool kept high in summer, low in winter. Major tributaries include: Long Tom River, Coyote Creek and Amazon Diversion Channel. Basin land use -- forestry, agriculture and urban (Veneta-Elmira, as well as Eugene)

Data - Limited quality (subject of EPA Clean Lakes Study), quantity data good (USGS continuous record)

Uses - Authorized uses of irrigation and flood control, but also a major regional contact and non-contact recreation site, major fish and wildlife habitat, and aesthetic resource; potential hydropower

Problems - Turbidity, algae, coliform (near shore), clay sediments, trash(?), pesticide spraying(?), conflicts among uses over managing reservoir levels

Impacts - Reduced recreational use, aesthetic degradation

7. AMAZON DIVERSION CHANNEL: West 11th to Fern Ridge

Characteristics - Wide, dredged flood channel with diked banks and a flat slope, diverts most Upper Amazon flow except peak flood flow from the original creek bed to Fern Ridge Reservoir; basin land use -- see 8 and 9 below, rest of basin is agricultural and open space with limited industrial development

Data - Quality and quantity data excellent, USGS gage, 3 NURP stations (Vegetation Management sites), 1 Clean Lakes station

Uses - Flood control, urban storm drainage, limited irrigation, bikeway planned, fishing, hunting, trapping, boating, fish and wildlife habitat, water quality enhancement

Problems - Trash, sedimentation, oil and grease, toxic metals, toxins, coliform, nutrients, low oxygen and chemical spills, low flow, difficult maintenance

Impacts - Chronic impact of toxics and sediment on biota, fish kills from spills, unaesthetic and unsafe for recreational use and sedimentation requires dredging, floatables and organics may impact Fern Ridge

8. UPPER AMAZON CREEK: Spencer's Butte to West 11th

Characteristics - Once natural creek -- dredged, channelized and partly cemented to provide flood relief and drainage; basin land use -- undeveloped hillsides, residential hills and lowland, some commercial and industrial, especially in the lower portion

Data - Quality and quantity data good to excellent, 4 NURP stations (sediment site, 29th, Washington, Oak Patch)

Uses - Non-contact recreation (parkway/bikeway), open space and wildlife, aesthetics, storm runoff flood control and drainage, water quality enhancement, development enhancement

Problems - Coliform, litter, oil, toxic metals, organics, pesticides, high temperatures, low oxygen, algal blooms, sedimentation, potential flooding, difficult maintenance, aesthetics

Impacts - Potential communicable disease, especially at Amazon Park and fairgrounds; concrete structure and trash limits aesthetics, wildlife,and streamside uses and water quality enhancement; potential biotic damage from metals, toxins and low dissolved oxygen; vegetation, litter and sedimentation require maintenance and reduce flood capacity

9. WILLOW CREEK: Entire Basin to Amazon Creek at West 11th

Characteristics - Natural intermittent creek, channelized at the lower end to drain and skirt an industrial area; basin land use -- undeveloped and rural residential but major potential development area for residential and industrial uses, some agriculture

Data - Almost none -- flow estimates possible

Uses - Storm runoff and drainage, minor irrigation, wildlife and three rare and threatened native plants

Problems - Poor soil drainage and limited flow capacity for development; development could destroy natural area value; no water quality problems suspected now

Impacts - Development is likely to increase runoff and add pollutants -- rare native plants could be destroyed

10. FLAT CREEK: North of Beltline to Willamette River

Characteristics - Major SCS drainage project converted small low land creek and wetlands to deep wide channel; basin land use -- predominantly agriculture, some residential (Santa Clara)

Data - None

Uses - Drainage and flood control; irrigation desired

Problems - Low flow (water quality?)

Impacts - Lack of water for irrigation

11. SPRING CREEK: Santa Clara to Awbrey Park and Willamette River

Characteristics - Small natural creek, normally year-round flow; creek bed largely unaltered; basin land use -- residential, park and agriculture

Data - Fair quality data, very little quantity data - estimates possible

Uses - Mostly aesthetic, wildlife, residential and parkside uses

Problems - Coliform (area on septic systems), some nutrients

Impacts - Unsafe for contact recreation

12. NORTH BELTLINE FLOODWAY: I-5 to Willamette River

Characteristics - Upper part is grass swale, lower part is major ditch with water year-round; area in low land; basin land use -- residential, vacant and open space and gravel removal

Data - Very limited quality data, no quantity data

Uses - Residential and rural drainage, flood control, wildlife habitat

Problems - Coliform(?), trash and litter, nutrients(?), sediment(?)

Impacts - Unknown, eutrophication likely in Willakenzie sloughs

13. DELTA PONDS CREEK: Willakenzie to Valley River Area and Willamette River

Characteristics - Large Willamette floodway and ponds with much subsurface flow, partly natural and partly borrow ponds from Delta Highway construction; basin land use -- open space, planned recreation (golf course), commercial shopping centers, residential

Data - Minimal quality data and no quantity data

Uses - Major wildlife use, trapping, fish habitat, aesthetics, recreation (fishing, boating, golf course), drainage and flood relief (most of pond areas are undeveloped parks)

Problems - Suspect nutrients, limited water circulation, heavy aquatic vegetation growth

Impacts - Suspected eutrophication of ponds

14. WILLAKENZIE FLOODWAY: Willakenzie Area to Willamette River

Characteristics - Mostly grass swale carrying storm water through low land to a Willamette slough and ponds at Beltline; basin land use -- residential and limited commercial

Data - No quantity or quality data

Uses - Drainage and flood control, wildlife area (lower area), aesthetics

Problems - Suspect nutrients, trash, coliform organisms

Impacts - Unknown, but probably causing eutrophication of receiving ponds and sloughs

15. EUGENE MILLRACE: Judkin's Point to 9th and Mill Street to Willamette

Characteristics - Historic Millrace altered by filling and development of Franklin Boulevard/Ferry Street Bridge access; pumped flow from Willamette; basin land use -- University of Oregon, residential, commercial and riverside industrial and park

Data - Good quality data, quantity data estimated, 1 NURP station (Eugene Millrace)

Uses - Receives storm drainage, park (duck pond at University), recreation (canoeing), wildlife, aesthetic residential and commercial focus, and special campus festivities, cooling water for power plant

Problems - Coliform, trash, nutrients, slow flow, heated recharge, ducks

Impacts - Unsafe swimming, contributor to Willamette River degradation, trash requires yearly removal, stagnation is unaesthetic, ducks increase coliform

16. ALTON BAKER PONDS AND CANOEWAY: Day Island Road to Ferry Street Bridge

Characteristics - Old Willamette River flood channel reconstructed as a recreational canoe route; canoe route flow siphoned from Willamette; reflecting pools built near lower end at Willamette; basin land use -- recreational (Alton Baker Park, Autzen Stadium) but contains a major completed landfill; ponds also receive discharge from Q Street Channel; some commercial focus

Data - Limited quality -- flow regulated

Uses - Canoeway, aesthetics, jogging path, park, commercial focus, fish and wildlife, planetarium, potential micro-hydropower

Problems - Bacteria, algae and weeds, organics, contamination from Q Street Channel at ponds

Impact - Ponds closed for swimming

17. "Q" STREET CHANNEL (MAIN): Mohawk Center to Alton Baker Ponds

Characteristics - Large deep drainage channel through lowland partially concrete lined; basin land use -- see 18, 19 and 20, also main Springfield residential area and some open and agricultural land between city limits of Eugene and Springfield

Data - Good quality and quantity data, 3 NURP stations (Centennial, Garden Way, 2nd Street)

Uses - Drainage and flood control, park and playground border, water source to Alton Baker Pond, minor water supply for herd of sheep, planned greenway, fish and wildlife habitat, temporary sewage overflow discharge

Problems - pH, coliform, organics, nutrients, litter, toxics, oil and grease, odor

Impacts - Unaesthetic, hazard for contact use, degradation of Alton Baker Ponds, extra cleaning at Alton Baker Ponds, occasional fish kills, probable chronic impact on biota, weed growth and difficult bank maintenance

18. "Q" STREET (NORTH SPRINGFIELD BRANCH): Harlow Road Area to I-5 at I-105

Characteristics - Some natural swale, mostly ditched in low area; basin land use -- open, residential and some commercial discharge to main "Q"

Data - None -- indirect estimates possible

Uses - Drainage, chlorinated sanitary sewer overflow

Problems - Coliform or chlorine residual

Impacts - Unknown impacts; during storms, chlorine kills coliform in main Q Street Channel, also, occasional chlorine failure causes excessive bacteria

19. "Q" STREET CHANNEL (SOUTH BRANCH): North 42nd to Mohawk Center

Characteristics - Moderate size deeply dug ditch through lowland area; basin land use -- major industrial and commercial areas, some residential

Data - Good quality data, fair quantity data, 1 NURP station

Uses - Drainage and flood flow, industrial cooling discharge

Problems - Color, organics, nutrients, oil and grease, odor, litter and floating materials, pH, toxics, high temperatures, coliform, chemical spills, aesthetics

Impacts - Degrades "Q" Street Channel, kills vegetation

20. "Q" STREET CHANNEL (NORTH BRANCH): McKenzie Slough to Mohawk Center

Characteristics - Small old irrigation ditch with McKenzie water and storm drainage from Marcola Road ditches; basin land use -- agriculture, residential, industrial

Data - Fair quality and quantity data, 1 NURP station

Uses - Drainage, irrigation, wildlife and fish habitat in parts (several ponds and woodlands)

Problems - Occasional spills, color, toxics(?) -- especially in Marcola ditches

Impacts - Fish kills documented but generally highest quality water supply to the "Q" Street Channel

21. GLENWOOD SLOUGH: Glenwood and Laurel Valley Branches to Willamette

Characteristics - Former natural slough and creek largely filled and piped but with some large open ponds and channels; basin land use -- industrial, commercial and suburban

Data - No data

Uses - Flood relief and drainage, wildlife habitat

Problems - Suspected nutrients and sediment, reduced circulation of slough water, runoff from solid waste transfer station

Impacts - Suspected eutrophication of open slough

22. SPRINGFIELD MILLRACE: Middle Fork Willamette River to Island Park - Willamette River

Characteristics - Historic Millrace and log pond; open except in culvert at Old Mill Shopping Center; water from the Middle Fork Willamette in controlled levels and from storm drainage; basin land use -- agriculture, industrial, rural residential, and Springfield downtown commercial

Data - Good quality data, fair quantity data, 1 NURP station

Uses - Drainage, fish and wildlife, industrial mill pond and cooling pond, feeds Island Park slough; and aesthetics for parkside developments, potential hydropower

Problems - Oil and grease, coliform, floating materials, trash, metals and toxics from downtown and industrial runoff

Impacts - Coliform hazard at Island Park has required swimming posting; unaesthetic accumulations of trash and sediment detract from park use; significant organic and coliform levels impact urban uses of Willamette River, especially during storms

23. RUSSEL CREEK: 30th Avenue Hills, Lane Community College (LCC), to Willamette

Characteristics - Small natural stream, some channelizing and ditching at I-5; basin land use -- forest, open hillsides, LCC, rural residential

Data - Very limited quality data, no flow data

Uses - Drainage, receives LCC sewage lagoon effluent, wildlife habitat, minor commercial discharge

Problems - Coliform, organics, oil and grease (on occasion)

Impacts - Unknown, but probably slight

24. BERKSHIRE SLOUGH: Goshen to Willamette

Characteristics - Natural slough and flood channel; basin land use -- predominantly open space and agriculture, also industrial and rural residential

Data - No data

Uses - Flood flow and drainage, fish and wildlife habitat

Problems - Unknown

Impacts - Unknown

25. McKENZIE RIVER: Walterville to Coburg

Characteristics - McKenzie is braided through much of this reach with a broad flood plain. The Mohawk River, Camp Creek and EWEB's Walterville Power Canal input on the north side of the McKenzie; direct basin land use -- see 26 and 27 below, plus extensive forest and agriculture, rural residential, parks, and gravel removal.

Data - All data good - USGS gages, DEQ monitoring sites

Uses - Domestic, industrial, irrigation and livestock supply, aquifer recharge, fish (anadromous) and wildlife, contact and non-contact recreation, aesthetics, hydropower, industrial waste assimulation, aesthetics

Problems - Warm temperature discharges, organics, coliform, odor, bottom materials

Impacts - At present, the McKenzie is not restricted from any beneficial use, and urban storm runoff is minor compared to industrial discharge and agricultural runoff

26. 42nd STREET DITCH: Main Street Springfield to McKenzie River

Characteristics - Wide deep ditch with slow flow, feeds McKenzie Slough; basin land use -- industrial and residential with commercial and open

Data - No data

Uses - Receives industrial point and non-point discharges, drainage, wildlife

Problems - Organics(?), toxics(?), bacteria(?), spill potential

Impacts - Unknown

27. EAST SPRINGFIELD SLOUGH: Southeast Springfield hills to Cedar Creek

Characteristics - Some natural creeks and sloughs, some channelized and two feeder ditches at 68th and 72nd; basin land use -- forested hillside, residential, commercial, agricultural and limited industrial

Data - Very little data, 1 NURP station on 72nd Street Ditch

Uses - Drainage, flood relief, fish and wildlife, aesthetics, some recreation, irrigation(?)

Problems - Flooding, coliform(?), sediment from hillside development, others(?)

Impacts - Turbidity to McKenzie, destruction of some channel bottom vegetation, sediment accumulation; other impacts unknown

28. POLK STREET STORM SEWER: Downtown Eugene to Willamette River

Characteristics - A major storm sewer drainage system entirely in pipes; basin land use -- downtown and strip commercial, medium-high density residential, some industrial, and park use

Data - Good quality and quantity data, 1 NURP station (Priority Pollutants)

Uses - Storm drainage, some industrial cooling water discharge

Problems - Coliform, organics, sediment, trash, metals, oil and suspected sanitary sewer leaks

Impacts - Quality impacts on Willamette River during storm runoff, unaesthetic visual from park bikeway and footbridge over Willamette, other impacts unknown; e.g., metals on fish and wildlife downstream

TABLE 4: UPPER AMAZON MONITORING STATION LAND USE CHARACTERISTICS

Land Use	29th Street		Washington		Oak Patch		Vegetation 1	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Residential	1280	41.7	2490	52.5	3800	54.6	5080	44.8
Low Density	1120	36.5	1400	29.5	2000	28.7	2800	24.7
Medium Density	0	00.0	810	17.1	1500	21.6	1860	16.4
High Density	160	05.2	280	05.9	300	04.3	420	03.7
Commercial	33	01.1	125	02.6	200	02.9	350	03.1
Strip Development	33	01.1	125	02.6	200	02.9	350	03.1
Parks & Open Space	38	01.3	270	05.7	400	05.8	650	05.8
Institutions	145	04.7	260	05.5	460	06.6	600	05.3
Industrial	0	00.0	0	00.0	41	00.6	141	01.2
Medium	0	00.0	0	00.0	41	00.6	81	00.7
Heavy	0	00.0	0	00.0	0	00.0	60	00.5
Agriculture	400	13.1	400	08.4	550	07.9	2400	21.2
Forest	1170	38.2	1200	25.3	1500	21.6	2100	18.6
TOTAL	3066	100.0	4745	100.0	6951	100.0	11321	100.0

TABLE 5: LOWER AMAZON AND POLK STREET STORMSEWER LAND USE CHARACTERISTICS

Land Use	A-3 at Wallis		A-3 at Bertelsen		A-2 Golden Garden		Polk Street Stormsewer	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Residential	6	01.0	8	00.8	730	44.1	304	39.4
Low Density	0	00.0	2	00.2	0	00.0	0	00.0
Medium Density	4	00.7	4	00.4	730	44.1	254	32.9
High Density	2	00.3	2	00.2	0	00.0	50	06.5
Commercial	74	13.1	93	08.8	115	07.0	341	44.2
Strip Development	74	13.1	93	08.8	115	07.0	114	14.8
Central Business	0	00.0	0	00.0	0	00.0	227	29.4
Parks & Open Space	85	15.0	435	41.2	280	16.9	50	06.5
Institutions	0	00.0	0	00.0	100	06.0	10	01.3
Industrial	402	70.9	520	49.2	280	16.9	66	08.6
Light	127	22.4	165	15.6	0	00.0	32	04.2
Medium	85	15.0	116	11.0	30	01.8	34	04.4
Heavy	190	33.5	239	22.6	250	15.1	0	00.0
Agriculture	0	00.0	0	00.0	150	00.0	0	00.0
TOTAL	567	100.0	1056	100.0	1655	100.0	771	100.0

TABLE 6: Q STREET LAND USE CHARACTERISTICS

Land Use	North Branch		South Branch		Second Street		Garden Way		Centennial	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Residential	45	07.8	545	46.6	1347	48.2	2194	50.0	2194	46.9
Low Density	40	06.9	0	00.0	190	06.8	670	15.3	670	14.3
Medium Density	0	00.0	450	38.5	1020	36.5	1305	29.7	1305	27.9
High Density	5	00.9	95	08.1	137	04.9	219	05.0	219	04.7
Commercial	0	00.0	120	10.2	185	06.6	225	05.1	260	05.6
Strip Dev.	0	00.0	95	08.1	140	05.0	180	04.1	215	04.6
Shopping Center	0	00.0	25	02.1	45	01.6	45	01.0	45	01.0
Open Space/Parks	135	23.4	300	25.6	550	19.7	810	18.5	870	18.6
Institutions	26	04.5	25	02.1	121	04.3	199	04.5	251	05.4
Industrial	70	12.2	180	15.5	290	10.4	350	08.0	350	07.5
Medium	0	00.0	80	06.9	100	03.6	110	02.5	110	02.4
Heavy	70	12.2	100	08.6	190	06.8	240	05.5	240	05.1
Agriculture	300	52.1	0	00.0	300	10.8	610	13.9	745	16.0
TOTAL	576	100.0	1170	100.0	2793	100.0	4388	100.0	4670	100.0

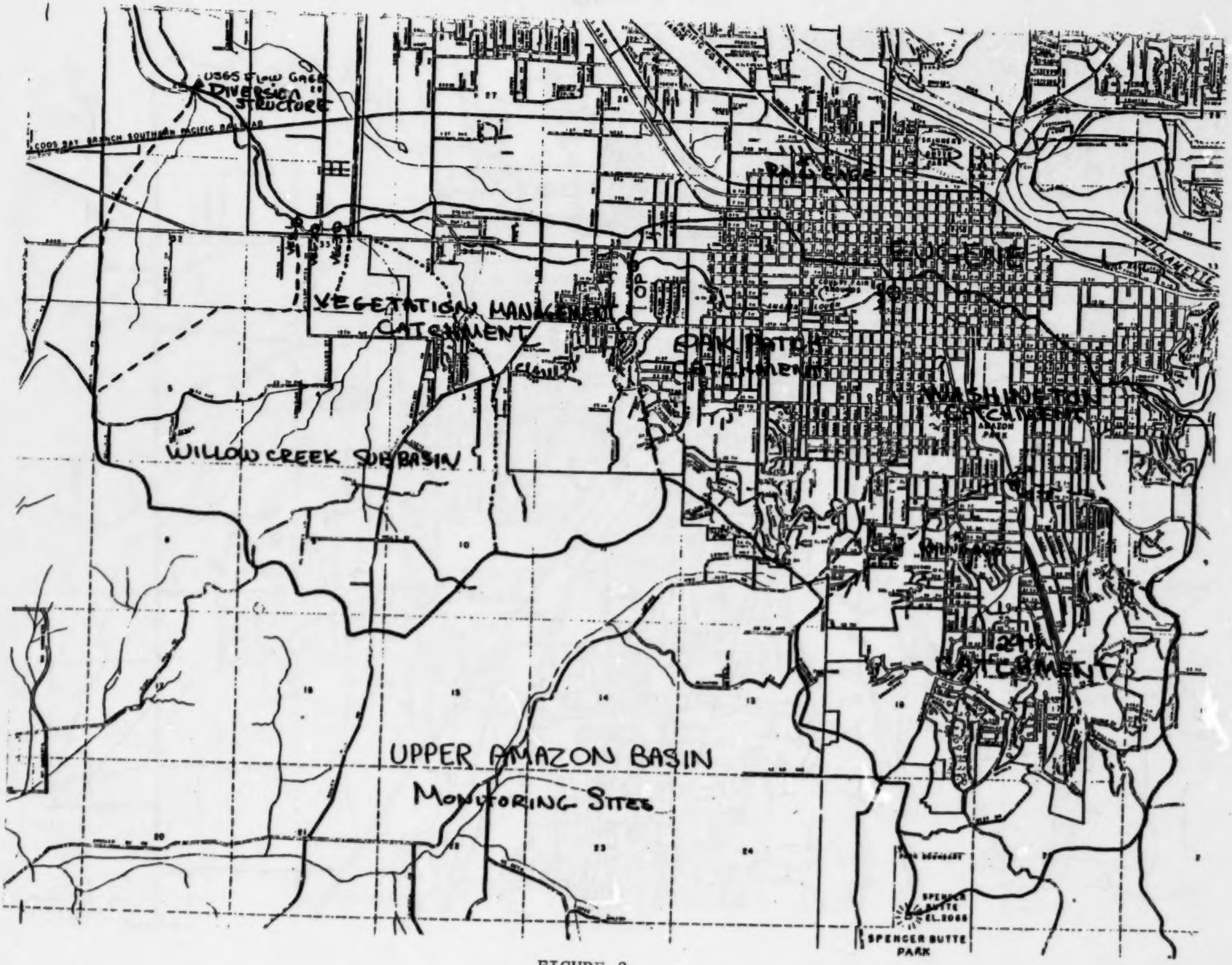

USGS Flow Gage
Diversion Structure
Coos Bay Branch Southern Pacific Railroad
Rain Gage
Eugene
Willamette
Vegetation Management Catchment
Oak Patch Catchment
Washington Catchment
Amazon Park
Willow Creek Sub Basin
24th Catchment
Upper Amazon Basin Monitoring Sites
Spencer Butte El. 2066
Spencer Butte Park

FIGURE 2
UPPER AMAZON BASIN MONITORING SITES

Reproduced from best available copy.

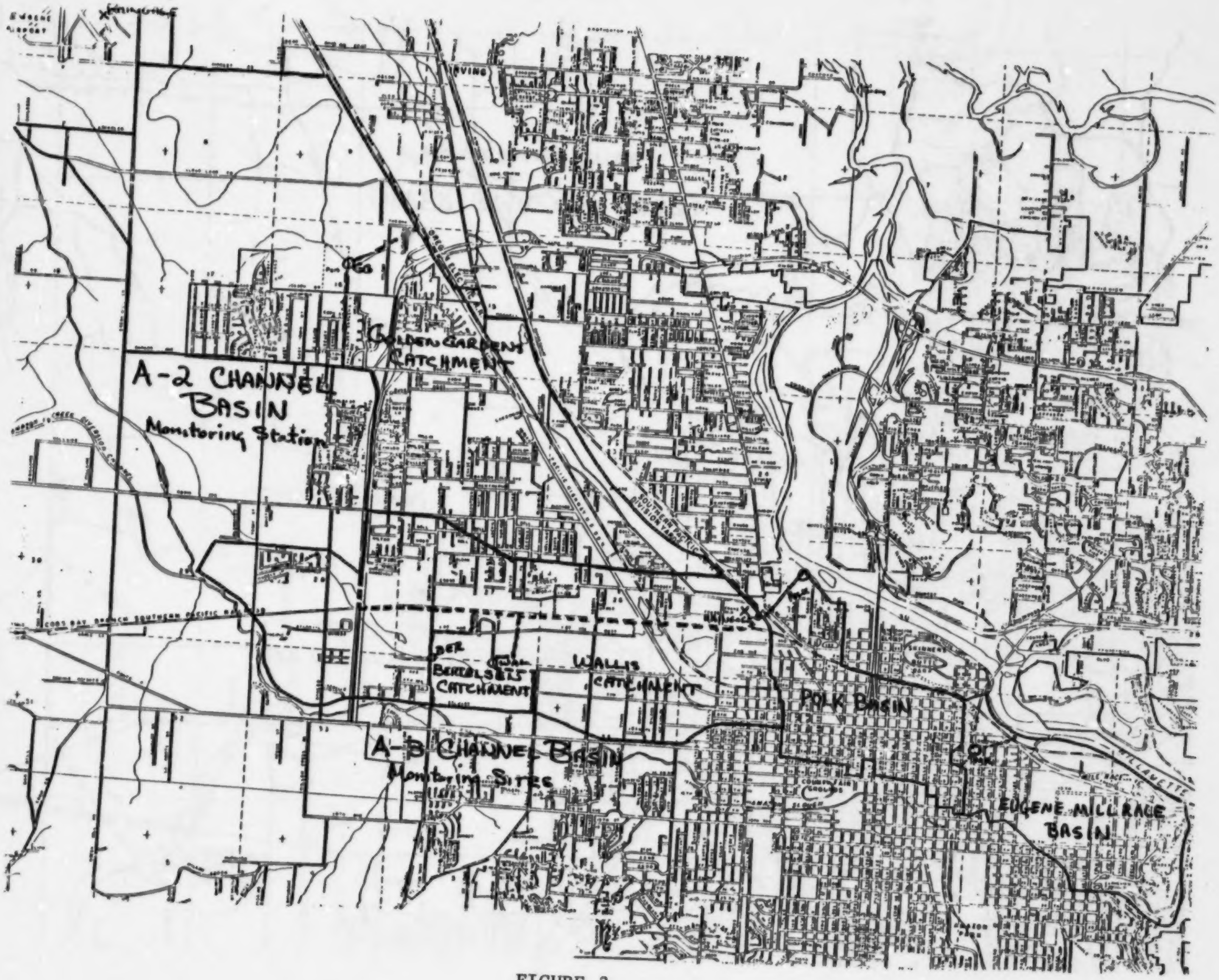

EUGENE AIRPORT
IRVING
GOLDEN GARDENS CATCHMENT
A-2 CHANNEL BASIN
Monitoring Station
BER
BERTELSEN CATCHMENT
WALLIS CATCHMENT
POLK BASIN
A-3 CHANNEL BASIN
Monitoring Sites
EUGENE MILLRACE BASIN
WILLAMETTE

FIGURE 3

OTHER EUGENE BASINS AND MONITORING STATIONS

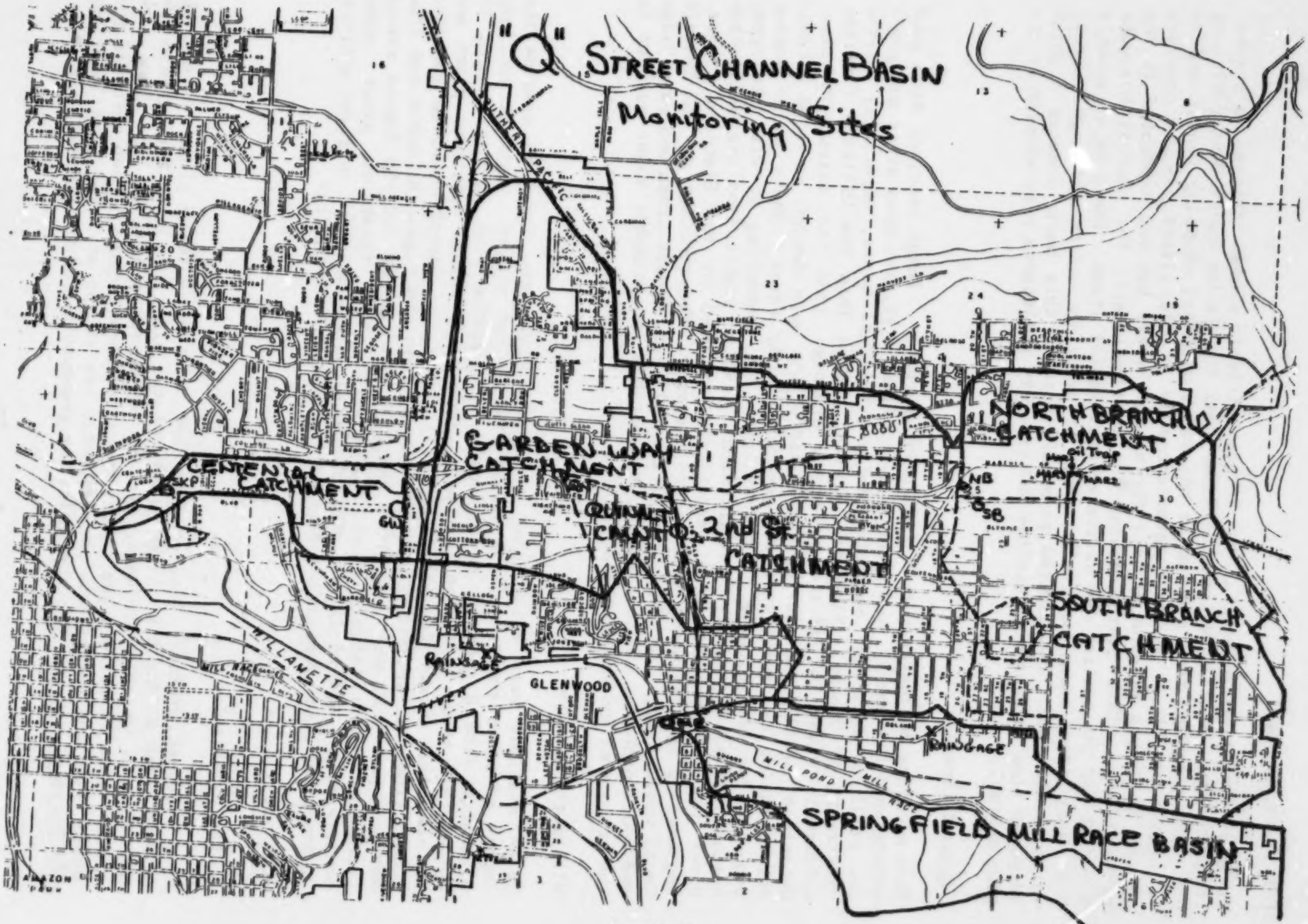

"Q" STREET CHANNEL BASIN
Monitoring Sites
NORTH BRANCH CATCHMENT
Oil Trap
MAR1
MAR3
MAR2
NB
S
SB
GARDEN WAY CATCHMENT
CENTENIAL CATCHMENT
SKP
GW
QUINALT CMNT
2nd St. CATCHMENT
SOUTH BRANCH CATCHMENT
RAINGAGE
GLENWOOD
RAINGAGE
MILL POND
MILL RACE
WILLAMETTE
SPRINGFIELD MILL RACE BASIN
AMAZON

FIGURE 4

"Q" STREET CHANNEL BASIN MONITORING SITES

Reproduced from best available copy.

Polk Storm Sewers--

The Polk Street storm sewer is the largest entirely closed drainage in Eugene. It discharges into the Willamette River near the Valley River Center bikeway and parkway bridge that crosses to the major regional shopping center and so is highly visible. The main interceptor is an old (1909) 94-inch concrete culvert which was originally used for sewage bypass but was separated in the early 1970's. This system drains the downtown mall, the central business district and the central and Whittaker residential areas. There have recently been many conversions or replacements of homes by medium and high density units in the area. The limited permeable area in this basin creates a quick response time to storms. Baseline and priority pollutants were sampled at the pipe outfall.

Eugene Millrace--

This millrace no longer serves industrial purposes. Large sections have gone underground due mainly to highway construction. Yet, its open areas and ponds are still an important aesthetic and recreational asset, especially to the University of Oregon. Slow moving water pumped into the Millrace from the Willamette River is diluted by storm drainage from the university area. Occasional baseline monitoring at the end of the open channel provided a basis for assessing the quality of its generally murky water. There is an active proposal for redeveloping of the Millrace and connecting it with the upper Amazon Channel through an "Emerald Canal." Water rights from the Willamette River for 150 cfs have been tentatively approved by the State of Oregon. Engineering and financing studies are underway. Construction of the Emerald Canal would change the character of the Millrace, Amazon Creek and Fern Ridge and would probably create a demand for boatable and swimable water quality in the urban area and Amazon Channel.

Willamette River--

Three stations were established along the Willamette River to examine the impact of urban runoff. The upstream station had minimal storm or sanitary discharge from Eugene or Springfield. the middle site was influenced by Springfield storm runoff and discharge from their sewage treatment plant and is near the intake for the Eugene Millrace. The downstream site received runoff from most of Springfield, as well as from the Eugene Millrace and from North Eugene. It was just above the Polk storm sewer and the Eugene sewage treatment plant (site of an expanded regional treatment plant under construction), and so did not show the total urban influence on river quality. In practice, most sampling was done during non-storm conditions.

Springfield

Q Street Channel--

The Q Street drainage lies in the flat alluvial outwash plain between the McKenzie and Willamette Rivers. Most of the older developed Springfield area is included in this drainage, and it represents a mix of land uses. The channel itself, follows the I-105 freeway and has generally been obscured from public view and recreational or aesthetic use except at a few park locations. The Metropolitan Land Use Plan calls for greenway use of the channel, but implementation is not scheduled. Monitoring stations were established at the mouths of two branches in the upper channel. The north branch is an old irrigation ditch from the McKenzie River and still receives about 2-5 cfs from that source. It has the only clean water in the system. Three stations were established on a north branch tributary road ditch to test a straw bale oil trap. The south branch is often highly polluted from industrial or commercial runoff and does not support normal aquatic vegetation. One site was established at the mouth of the south branch. Three additional stations on the main channel recorded residential input, passive vegetation treatment and water quality discharging to Alton Baker Ponds.

Springfield Millrace--

The Springfield Millrace originates from the Middle Fork Willamette River and passes through agricultural bottomland before reaching its industrial destination, where it is presently used as a log pond. In the absence of storm runoff, the Millrace exhibits excellent water quality, but the earlier 208 Study revealed filthy storm input from the Main Street industrial and commercial storm drains. The Millrace has potentially high but undeveloped aesthetic appeal which is impaired by urban runoff contamination at the lower end. Contaminated water from the Millrace ends up in a large park (Island Park) along the Willamette. Base and storm flow samples were collected near the mouth of the Millrace.

72nd Street Channel--

The eastern end of Springfield is developing very rapidly and storm drainages and capacity are under scrutiny of the City (Brown and Caldwell, 1979). Development is occurring on steep hillsides, as well as the flatter McKenzie Valley and local flooding problems occur. A monitoring station was established on the 72nd Street drainage subbasin to examine sediment loads.

SECTION III

DATA BASE

RAINFALL

We examined rainfall in terms of storm patterns in historic data, areal distribution in the Eugene/Springfield region and to a limited extent, chemical makeup. Each of these factors was important because few urban runoff analyses have been conducted in regions where long, steady frontal storms rather than short, intense thunderstorms predominate. The airport weather station is located northwest of Eugene on the open Willamette Valley floor. Areal analysis was desired to determine whether significant localized differences in rainfall patterns existed. The four local stations chosen also provided greater accuracy in storm rainfall-runoff quantity and quality analysis. Finally, we completed a limited wetfall-dryfall monitoring effort to examine air quality and rainfall as a source of urban runoff contaminants.

Storm Analysis Methods and Results

Thirty plus years (1948-1978) of computerized rainfall data at the Eugene Airport were obtained from the U.S. Weather Service. Those records were used with the Hydroscience Synoptic Rainfall Data Analysis Program (SYNOP) to provide a statistical analysis of storms. Defining separate storms is a key problem in this analysis. In areas where thundershowers and storms predominate, a three to six hour interval without rain is used to distinguish between separate storms. Initial attempts to run SYNOP with three and four hour "interevent" times resulted in more "storms" than the program could handle. Intervals of 6, 12, 24, 30 hours were also run, and 30 hours turned out to be the statistical "true" storm interevent time.

Use of such a long interevent time, though statistically meaningful, does not coincide with the storm drainage and urban runoff problems. The time of concentration of significant storms is generally six hours or less for open channels. After 12 hours without rain, flows will be either near base flow or rapidly depleting and after 24 hours will be at base levels.

Figure 5 illustrates how differing interevent times affect the average storm statistics. If one defines separate events as those separated by six hours without rainfall, half of the storm events in the Eugene/Springfield area would be followed by another storm within 24 hours. Most storms actually are a series of fronts packaged in a single pressure system. Table 7 shows a typical winter hourly rainfall record having those patterns. In terms of monitoring, it was not possible to sample an entire multi-frontal system of storms. We used a three to six hour interval without rain as a break-off point for sampling.

SYNOP also provided average monthly storm statistics and "frequency of recurrence" data. Key statistical graphs are reproduced in Appendix A. These figures are based on the six hour interevent time. Individual storms often include several hours without rain. Seasonal differences in average storms coincide with the average monthly precipitation data. Average storms are much longer, have higher volume and are most frequent during November through

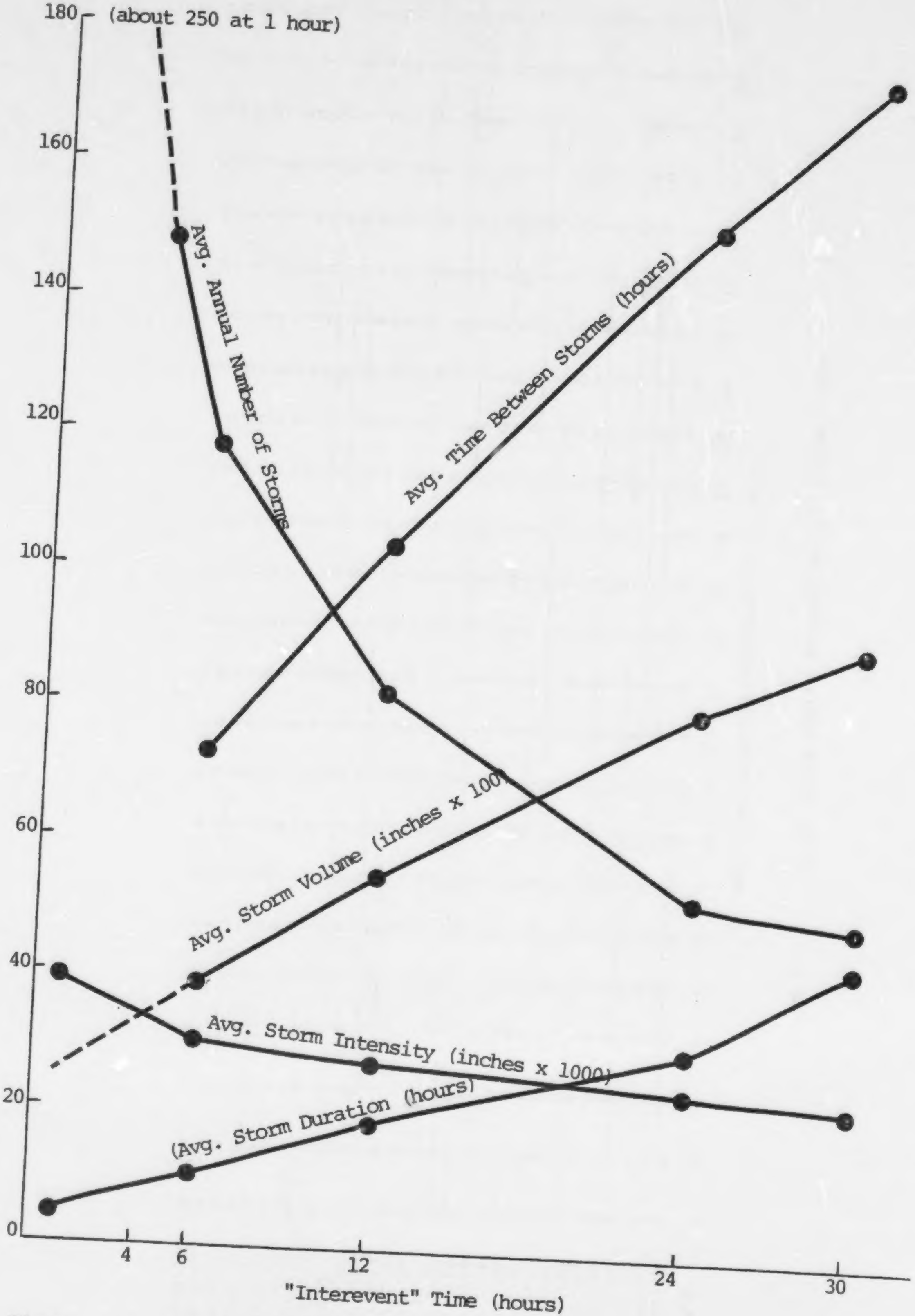


Figure 5 : The effect of differing "interevent" times on SYNOP average storm statistics.

TABLE 7: TYPICAL WINTER MONTHLY RAINFALL RECORD, EUGENE AIRPORT

HOURLY PRECIPITATION-HUNDREDTHS OF AN INCH

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01/01/56	0	0	4	2	5	8	2	4	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
01/02/56	0	0	0	0	0	0	0	0	0	1	1	0	1	2	6	4	1	0	0	0	0	0	0	0
01/03/56	0	0	0	0	0	0	0	0	0	1	1	4	6	5	2	11	8	4	2	0	0	0	3	9
01/04/56	4	3	6	11	11	5	1	16	25	7	1	0	0	0	4	6	2	4	14	15	14	4	0	0
01/05/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/06/56	0	0	0	0	0	0	10	28	22	8	8	10	12	12	13	12	9	7	3	0	0	1	8	5
01/07/56	4	4	4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	8	2	0
01/08/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/09/56	0	0	0	0	0	1	1	2	2	9	7	5	1	2	2	0	0	1	0	0	0	0	0	0
01/10/56	0	0	0	0	0	0	0	1	1	3	2	0	0	0	0	1	2	2	1	2	1	1	1	1
01/11/56	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/12/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	19	10	5	0	0	0
01/13/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/14/56	4	5	5	4	4	1	1	2	2	1	8	8	6	10	19	9	4	0	2	0	0	4	18	0
01/15/56	8	2	9	11	12	14	18	6	1	0	0	0	0	3	0	0	0	4	9	5	11	6	9	5
01/16/56	9	2	2	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
01/17/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	8	8	2	4	2
01/18/56	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/19/56	0	0	9	11	6	1	1	2	0	0	0	4	1	3	0	0	0	0	0	0	0	0	0	0
01/20/56	0	0	9	8	3	2	2	6	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
01/21/56	0	0	0	0	0	0	0	0	0	0	4	2	6	0	0	0	4	4	0	0	0	0	0	0
01/22/56	0	5	3	3	3	4	6	4	0	6	14	0	0	4	2	3	18	3	0	0	0	0	6	2
01/23/56	0	0	0	0	3	1	0	0	0	0	0	0	0	0	4	7	14	5	2	0	0	0	0	0
01/24/56	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/25/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/26/56	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/27/56	0	0	2	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/28/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/29/56	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/30/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/31/56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

January. February and March have storms as frequently but storms are shorter and have less volume. The least frequent storms with the shortest duration and smallest volume occur in July and August. Average storm intensity is very low during all months and ranges from .026-.036 inches per hour.

Areal Distribution

Recording rain gages were installed in Eugene at a fire station on 33rd Avenue near Donald and at the Public Works Maintenance Shop on Roosevelt Boulevard (Figure 2). The fire station gage had a 20 inch capacity and a 168 hour spring wound clock. The yards gage was a tipping bucket model. Noncontinuous records were kept at the Springfield sewage treatment plant and the Public Works Maintenance Shop (Figure 4), using cumulative glass rain gages. Rainfall amounts were recorded during weekdays at 8 a.m., noon and 5 p.m. Because of the differing time period (8 a.m. to 8 a.m. versus midnight to midnight), Springfield data was compared with Eugene and airport data on a storm rather than daily basis.

The Eugene tipping bucket gage developed problems with sensitivity to wind disturbance that ruined much of the record. The spring wound clock gage had the fewest problems. Daily precipitation records were determined by evaluating the chart. Precision of daily readings (other than zero) was about ±.03 inches; however, the cumulative seven day precision is similar because in most cases, negative errors in the interpretation of one day would be followed by positive error on a following day. Hourly records were determined from the charts for most storms with a volume greater than .15 inches. A similar error situation occurs during storms. Although each hour may be off by .03 inches, the overall storm volume is also generally precise, to within .03 inches. The fire station daily data were compared statistically with the airport data and plotted in Appendix A. The rainfall averaged 37 percent less at the fire station, which was the opposite of earlier consultant predictions. The fire station gage was recalibrated following analysis and found to be reading 2.5 percent less than true values. Gage location on the fire station roof was free of overhead interference but could have resulted in limited interference from updrafts. We do not expect any major interference and would predict that there is normally at least 30 percent less average rainfall on the lee slopes of the south hills of Eugene.

Rainfall values from the Eugene Public Works yards tended to be less than at either the airport or the fire station. However, wind interference negated many readings, so statistical evaluation was not completed.

Springfield data from the Public Works maintenance yards were normally rounded to the nearest 0.1 inch, although occasionally .05 or .025 were used. Records for December 1979 to May 1981 were fairly complete. Statistical comparison was based on storm periods separated by at least a full day without rain. Forty-five storm periods were compared, and there was a strong correlation for equal average rainfall at the airport and Springfield Public Works yards, but standard error was high due to the limited number of observations.

Fewer measurements were recorded at the Springfield sewage treatment plant where values were read to the nearest hundredth of an inch. For 22 observations, there was a tendency towards 15 percent less rain at the Treatment Plant. However, the low number of readings also resulted in a high standard error, and one could not say with any certainty that average rainfall there was different than at the airport. During individual storms, some rainfall was recorded at each station in nearly every instance. These data analyses are also included in Appendix A.

Dryfall-Wetfall

Limited samplings of wetfall and dryfall were taken at the Eugene Airport and the Springfield Treatment Plant. Samples were collected in two gallon plastic tupperware containers with nine inch diameter openings. The containers were mounted five feet above the ground. Several samples were negated by vandalism or bird droppings. Two samples from the airport containing dryfall and wetfall and two dryfall samples from the treatment plant were successfully collected and analyzed (Table 8). One small wetfall sample from the Springfield Treatment Plant was collected. The sample covered six days. During three of those days, 0.33 inches of rain fell. Wetfall COD was 64.6 mg/l, conductance was 43 mg/l, nitrogen was 0.37 mg/l and phosphorus was 0.057 mg/l. Although limited, the data imply that significant concentrations of some materials, particularly phosphorous, accompany dryfall and that wetfall may contain significant organic loads during the summer.

FLOW AND DISCHARGE

Earlier 208 urban runoff studies included analysis of discharge data and modeling of the major study basins (Jorden/Avent and Associates, 1977). It was not deemed necessary to repeat those efforts due to the time and expense of purchasing, establishing and maintaining continuous recording flow gages. We opted instead for calibrating a series of stage discharge curves to approximate flows during water. quality sampling. These curves were supplemented by a single USGS continuous gage on Amazon Creek.

Equipment and Methods

Two sites were established by contract with the USGS. One was the continuous recording gage on Amazon Creek at the diversion structure near Royal Avenue, the second was a staff gage installed on Q Street Channel at a culvert with a weir at the crossing of Garden Way Road. The discharge rating was determined by hydraulic formulas and field testing. Flow values for the Willamette River were based on daily river stage recordings taken near the Ferry Street Bridge by the Eugene Water and Electric Board. Stage flow relationships were determined by the Corps of Engineers several years ago.

Eugene and Springfield installed staff gages at 12 water quality monitoring stations. Gage height was recorded during water quality monitoring. Flow measurements were taken at low, medium and high stages, using a Marsh/McBirney Model 201 portable electronic flow meter. Depending on water depth, flows were either recorded at 0.6 of depth or at 0.2 and 0.8 of depth. The number of readings across the channel depended on width and regularity of the channel bottom. Flows were plotted on double logarithmic graph paper with constant adjustments made for gage readings to come up with the best straight line stage chart. Amazon Channel average daily flows at the continuous gage are shown in Appendix B.

TABLE 8: DRYFALL-WETFALL DATA

	AIRPORT				SPRINGFIELD TREATMENT PLANT			
	8/5/80 - 9/9/80 Dryfall = 35 Days Wetfall = .23 Inches		9/9/80 - 10/30/80 Dryfall = 44 Days Wetfall = 2.42 Inches		8/3/80 - 9/10/80 Dryfall = 36 Days Wetfall = .04 Inches		9/10/80 - 10/30/80 Dryfall = 44 Days Wetfall = 0 Inches	
SAMPLE STATISTICS	Mass/m^2/Day	Mass/l	Mass/m^2/Day	Mass/l	Mass/m^2/Day	Mass/l	Mass/m^2/Day	Mass/l
Residue (total) (mg)	27	171	80	58	73	-	78	-
Residue nonfilterable (mg)	18	108	60	43	55	-	67	-
Nitrate-Nitrite-N (mg)	.13	.83	-	-	.21	-	.08	-
PO - P (total) (mg)	.14	.88	.75	.54	.24	-	.17	-
Fe (total) (mg)	.43	2.67	.82	.59	1.02	-	.83	-
Pb (total) (ug)	22	133	41	29	-	-	11	-
Zn (total) (ug)	20	125	88	63	45	-	1.1	-
Cu (total) (ug)	3.8	33	11	7.9	5.4	-	4.4	-

Dryfall rate attributes all mass collected to dryfall; actual value will be less.

Wetfall concentration attributes all mass collected to wetfall; actual value will be less.

At all but two sites, both on the A-3 Channel, measured flows produced discharge curves which appear to be within 20 percent of the true value during our period of study. The A-3 sites at Bertelsen Road and Wallis Road were plagued by continually changing controls. Wallis Road changes were due to a beaver dam and Bertelsen changes were due to vegetation growth and channel obstructions. Both sites were low velocity channels even at high flows.

Flow values for water quality monitoring at these sites were estimated from field notes and flow readings taken around the time of sampling. Their range of accuracy is probably not better than ±50 percent in most cases.

Polk Street storm sewer flows were initially computed for staff gage reading in an underground structure near the Willamette River. The structure was closed off during the study and flow measurements were taken at the storm sewer outfall by painting surveyed 0.1 foot height intervals on the sewer walls. Flows were computed from the Manning formula and checked by velocity measurements and were deemed accurate to ±20 percent.

Results

Calculated flow measurements and rating curves are reproduced in Appendix B. Hourly flow readings at the USGS Amazon gage were plotted for storm periods in which monitoring occurred (Figures 6, 7, 8, 9 and 10). Rainfall values are also plotted on these graphs. The combined rainfall-runoff data illustrate the difficulty of defining and monitoring a typical northwest storms since many have numerous peaks. These graphs can be used to improve the estimate of storm runoff pollution concentrations at other stations by evaluating discharge and time of concentration relationships between a staff gage station and the USGS gage.

WATER QUALITY

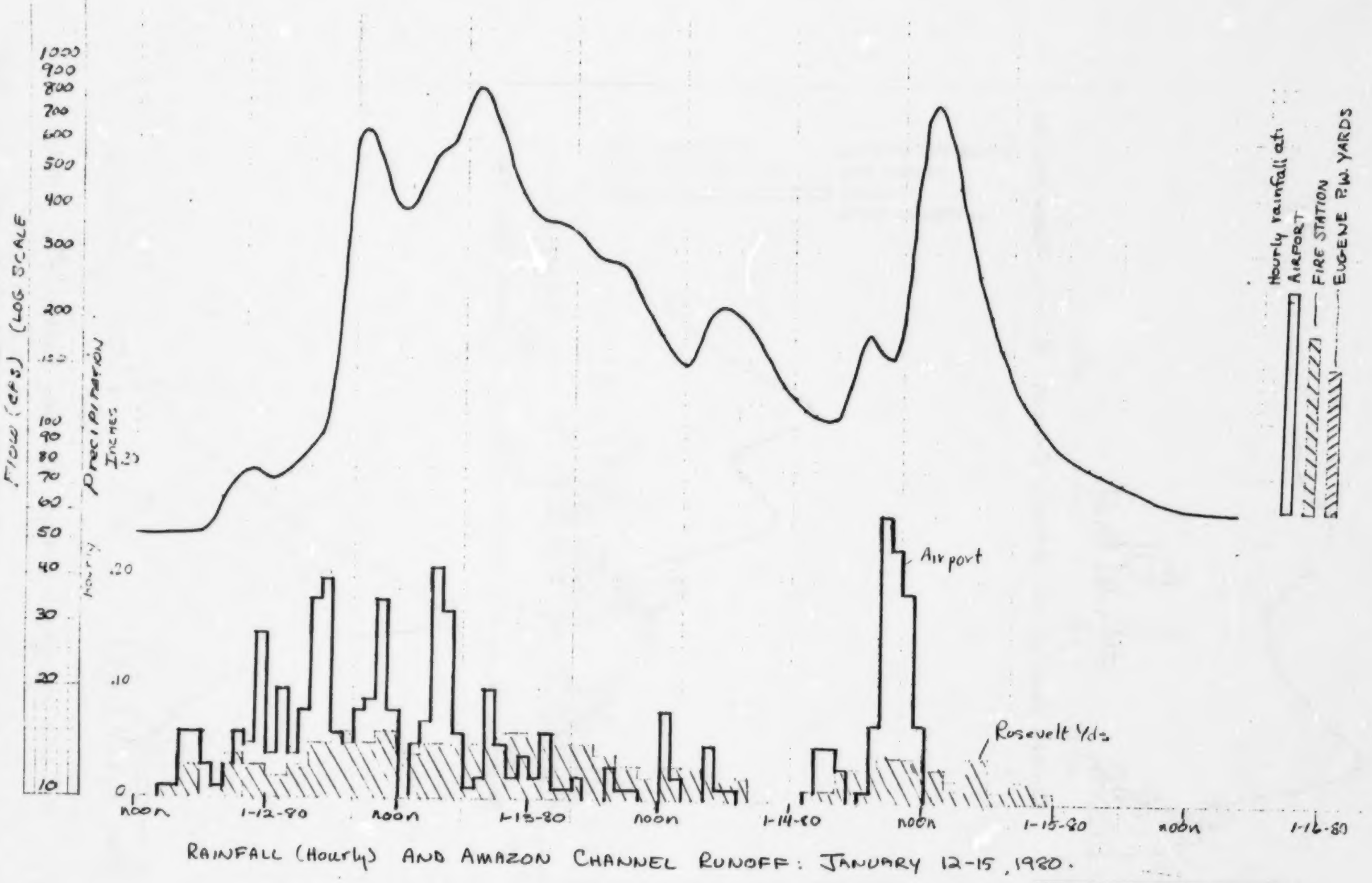
Site Locations

Water quality stations are shown in Figures 2, 3 and 4 and were described with pertinent fixed site data in the previous section. Sites were chosen to represent the majority of situations in the Eugene-Springfield area. A brief summary of these sites (Table 9) shows the range of coverage of sites.

Most of the work centered on the two largest and longest basins (Amazon and "Q" Channels) which drain the majority of land area of each city and have the greatest concentrations of park uses. Pilot study work was concentrated in these basins.

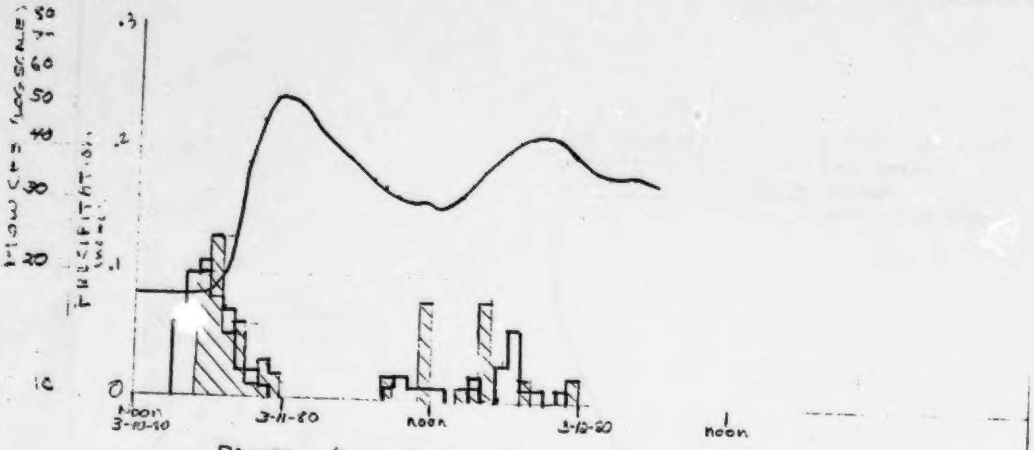
Methods/Equipment/Personnel/Quality Assurance

Quality assurance protocol for water quality sampling and analysis were approved by EPA in spring 1980. Basic field and laboratory test procedures are included in Appendix C, along with STORET codes and other water quality data.

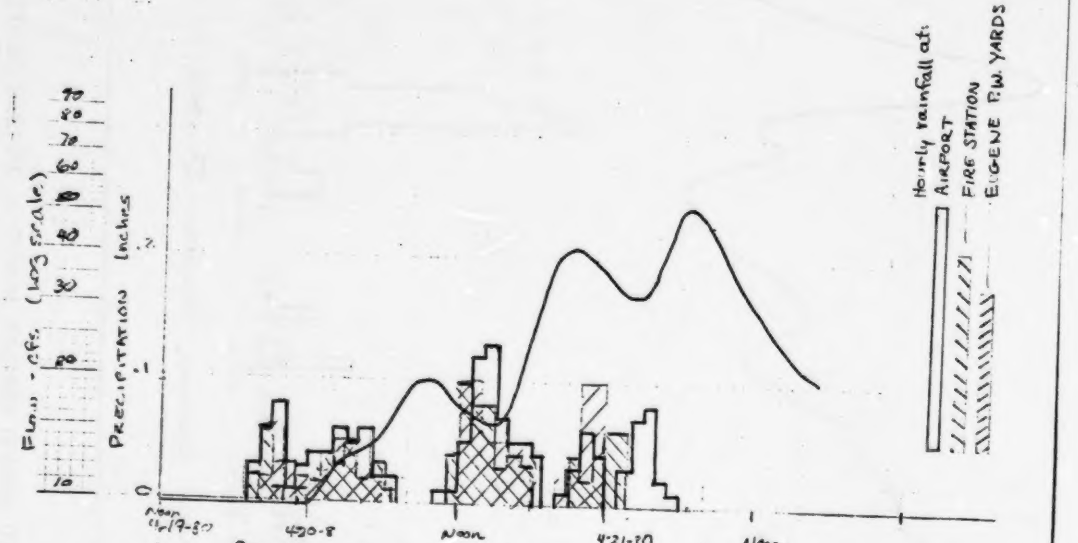


Reproduced from best available copy.

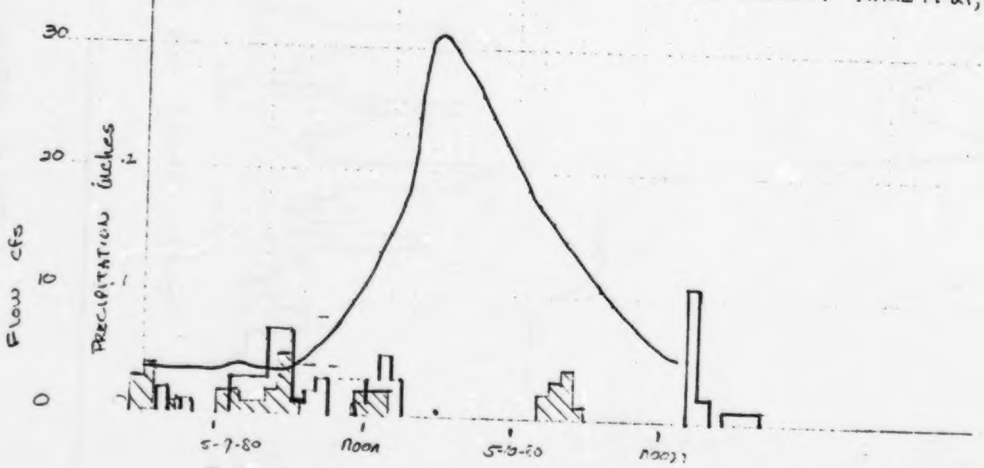
FIGURE 6: RAINFALL AND AMAZON CHANNEL RUNOFF - JANUARY 12-15, 1980



RAINFALL (hourly) AND AMAZON CHANNEL RUNOFF: MARCH 10-12, 1980.

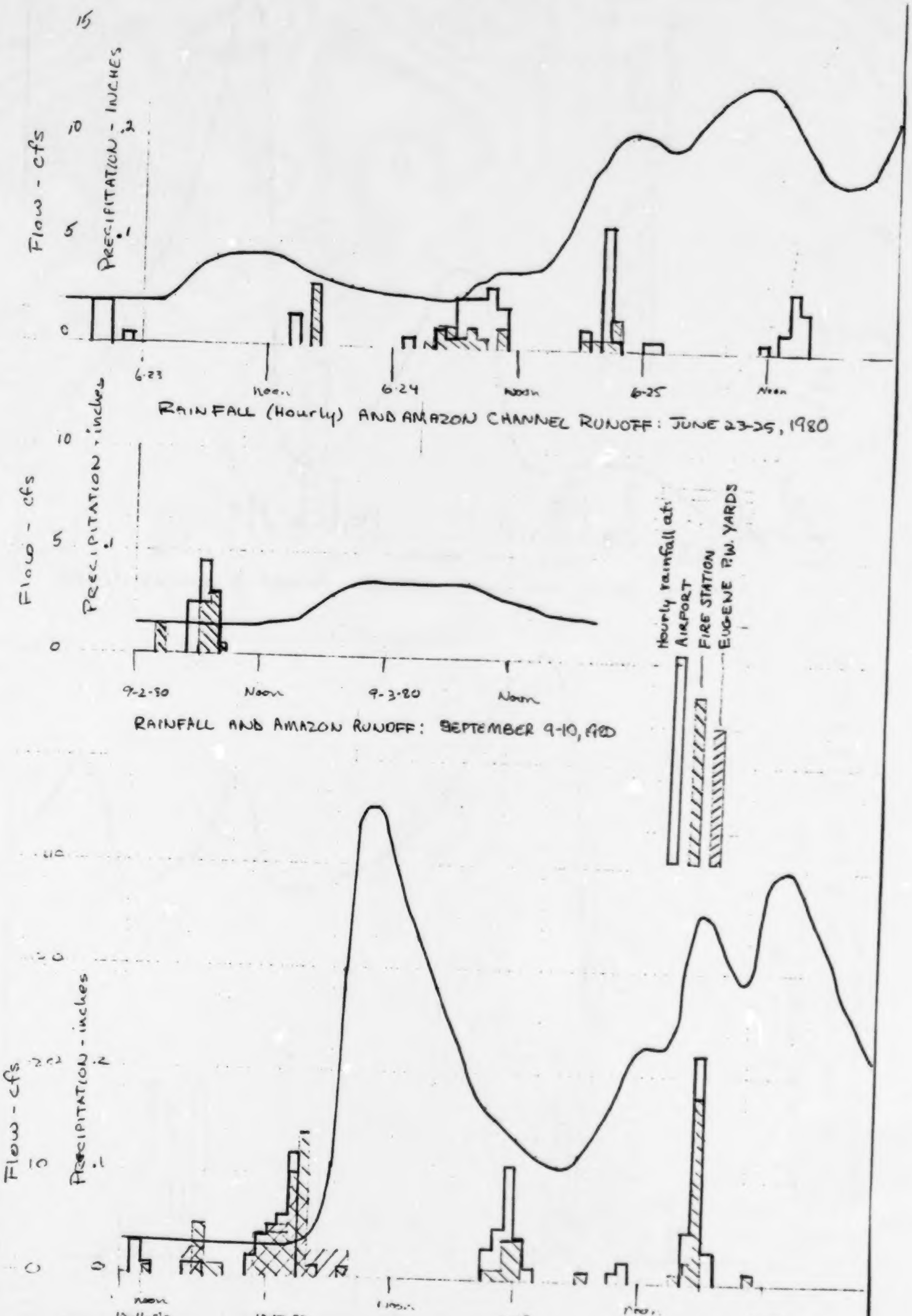


RAINFALL (Hourly) AND AMAZON CHANNEL RUNOFF APRIL 19-21, 1980.



RAINFALL (Hourly) AND AMAZON CHANNEL RUNOFF MAY 9-10, 1980.

FIGURE 7: RAINFALL AND AMAZON CHANNEL RUNOFF - MARCH 10-12, MAY 9-10, 1980

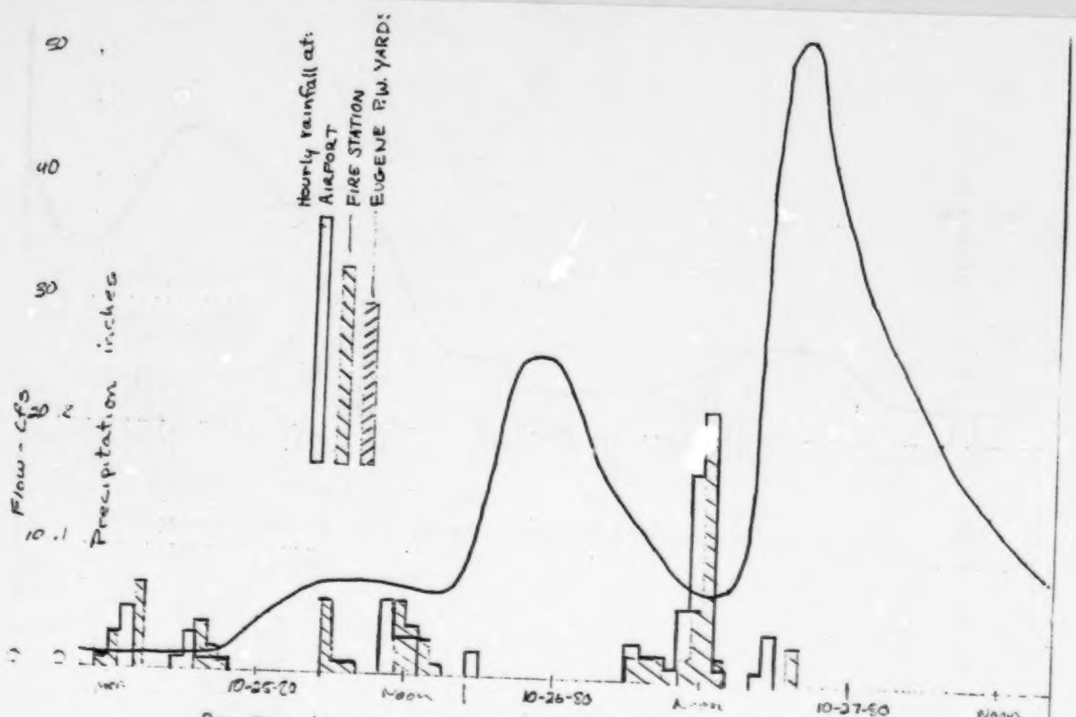


RAINFALL (Hourly) AND AMAZON CHANNEL RUNOFF: JUNE 23-25, 1980

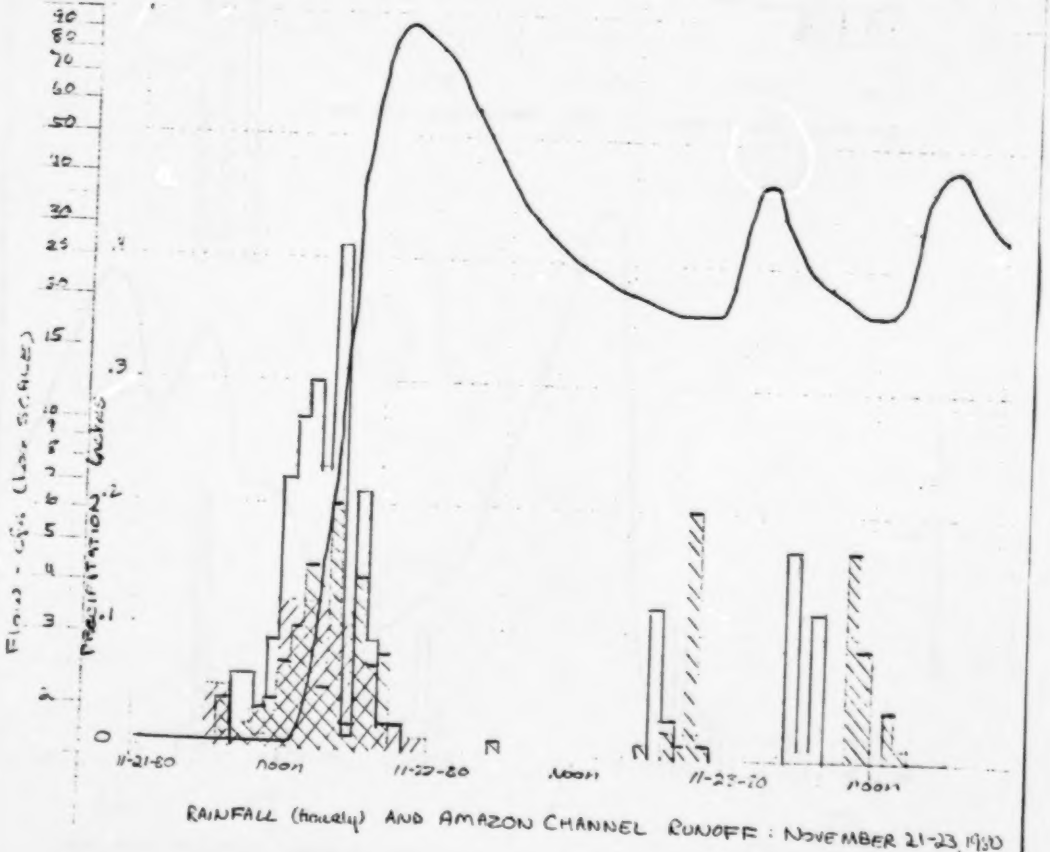
RAINFALL AND AMAZON RUNOFF: SEPTEMBER 9-10, 1980

RAINFALL (Hourly) AND AMAZON CHANNEL RUNOFF: OCTOBER 11-14, 1980

FIGURE 8: RAINFALL AND AMAZON CHANNEL RUNOFF - JUNE 23-25, SEPTEMBER, 9-10 AND OCTOBER 11-14, 1980



RAINFALL (Hourly) AND AMAZON CHANNEL RUNOFF: OCTOBER 25-27, 1980



RAINFALL (Hourly) AND AMAZON CHANNEL RUNOFF: NOVEMBER 21-23, 1980

FIGURE 9: RAINFALL AND AMAZON CHANNEL RUNOFF- OCTOBER 25-27, and NOVEMBER 21-23, 1980

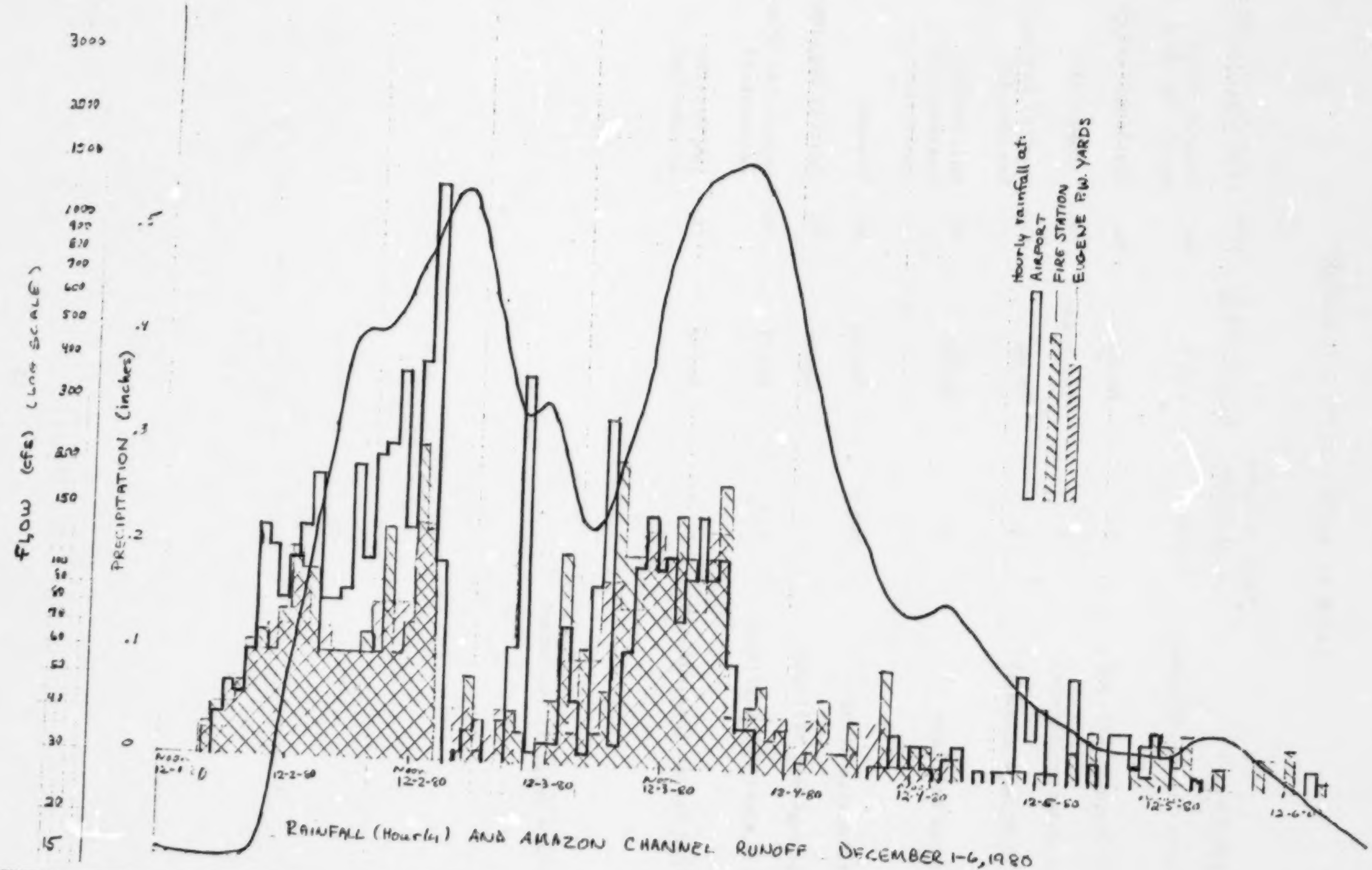


FIGURE 10: RAINFALL AND AMAZON CHANNEL RUNOFF - DECEMBER 1-6, 1980

TABLE 9: WATER QUALITY SITE SUMMARY

Storm Basin	Major & Minor # of Sites	Lineal/Pilot	PP*	Land Use/Character
Amazon Channel (Eugene)	3+4	Yes/4	No	General urban; mostly residential
A-2 Channel (Eugene)	1	No/No	No	Residential/Open
A-3 Channel (Eugene)	2	Yes/None	Yes	Industrial
Polk Street (Eugene)	1	No/No	Yes	Central Business/ Residential
Eugene Millrace	1	No/No	No	University/ Residential/ Industrial
Willamette River	2+1	Yes/No	No	General
Springfield Millrace	1	No/No	No	Central Business
Q Channel (Springfield)	5+3	Yes/3	No	Industrial/General Residential
72nd Street (Springfield)	1	No/No	No	Low Density Residential

---

*PP = Priority Pollutant

In general, all samples were gathered using grab sample techniques from shore or dipped out of center channels. Extension arms were used, as necessary, to make sure samples were representative of the main current. Sample personnel varied with the sample time but was organized around L-COG 208 staff, Eugene Public Works Maintenance crews and Springfield Wastewater Facility staff. Field records were kept for all samplings and duplicates were taken approximately in 10 percent of the samples. Testing was done by the Lane County Health Division Water Laboratory, except for testing of "Oil and Grease," "Total Organic Carbon," and "Kjeldahl Nitrogen" tests which were performed by Chinook Laboratories, Corvallis, Oregon.

Storm/Background Monitoring

Overall, an attempt was made to balance storm monitoring with a monthly series of background samples. The rationale behind this strategy lies in the characteristic differences between seasonal background flows and because most channels maintained a year-round flow. In practices it was much easier to collect the monthly samples than the storm events, particularly since there were frequent "false alarms" on storms and especially since no effort was made to monitor more than one of the winter "long" storms with rainfall periods lasting as long as five days. As a result, the number of storm and background samples was approximately equivalent for those sites where storm monitoring occurred.

It was not possible to monitor all sites of concern during storm periods due to equipment, staff and logistical problems. The sites monitored during storms focused on the Amazon and A-3 Channels' stations with less frequent monitoring on the Q Channel and the Springfield Millrace. These data are supplemented by data collected during the previous urban runoff programs. The "Storms Data Catalog" (Appendix C) for Eugene, gives a perspective on the type of information that was collected during storm events. STORET statistical summaries of water quality at each station are provided in Appendix C. All data are listed in the STORET printout available in the data files. In general, it is easiest to determine whether a sample represents a storm or background by whether more than one sample was taken during a single day. However, some background samples also contained considerable storm runoff so flow values should also be considered. The difficulty with the flow method is that background flow values in January are often ten times greater than storm flows in the period from June through September. A thorough knowledge of storm systems, characteristics and weather conditions on sampling dates was often necessary to allow an accurate evaluation of monitoring data. The rainfall and Amazon Channel runoff charts (Figures 6, 7, 8, 9 and 10) were prepared in order to analyze monitored storms.

Data Record

In addition to the data record listed here, Section IX, "Executive Summary," part "Work Task Outputs" lists the data tabulation outputs for Work Task #3, Monitoring.

In addition to STORET organization and entry (no mean feat and quite time consuming), data prepared from field and laboratory sheets are entered on the L-COG data file system, from which various formats were developed. Primary among these are the flow concentration records, lineal stream comparisons evaluation of worst values, and data analysis necessary for the Vegetation, Biological Reconnaissance, Street Sweeping and Sediment Trap Pilot Studies. Special monitoring efforts are listed in the following section.

Special Monitoring Efforts

Priority Pollutant Sampling--

Priority pollutant composite samplings were completed at the A-3 Bertelsen and Polk storm sewer monitoring stations during two storms. The land use, physiographic and soils characteristics of these drainage basins are listed in Tables 10, 11 and 12. The storms were (relatively) short duration spring and fall storms. We chose storms in which rainfall during the previous 24 hours was insignificant and monitored runoff until flows returned to 10 percent of the peak flow. Exhaustive EPA quality assurance procedures and recommendations were followed (Versar, Inc., 1980). Composite samples were collected by grab sampling on a flow proportional basis. Rainfall and runoff characteristics and sample timing are shown in Figures 11 and 12. A summary of results of the special analysis is given in Table 13. Of the 129 priority pollutants, 29 were detected. All compounds were detected at equal to or less than five micrograms per liter except pentachlorophenol, tetrachloroethylene, methylene chloride and methylchloride. The first two are common industrial chemicals used in the area. The single high methylene chloride value could be from incomplete rinsing of the vial. Special metals analyses were also completed by two laboratories and are reported in Versar, Inc. (1982) and included in the L-COG NURP data base.

Biological Reconnaissance--

Macroinvertebrate and periphyton species and population data were collected as part of the biological classification of the Amazon Channel. Because of the unusual nature of this data, it was not entered into STORET but was stored in an L-COG computer file. It is the subject of a separate report, the Biological Reconnaissance of an Urban Drainage System. The background data for this report are in L-COG files.

Vegetation Management--

The data collection necessary to develop the vegetation management study included vegetation species and cover, cattail (Typha latifolia) standing crop values and tissue metals concentrations taken from the same reaches for which periphyton and macroinvertebrate data were collected. This study utilized the biological reconnaissance data, as well as ambient water quality data collection from three stations. Two of the water quality stations were established specifically for this study. The vegetation data are published separately, and raw data files are maintained at L-COG, including a computized file on plant coverage. It was not possible to enter this data into STORET because of its specialized nature. Limited cost data were developed and are included in the report.

TABLE 10

PRIORITY POLLUTANT CATCHMENTS

LAND USE DISTRIBUTION*

LAND USE CATEGORY	POLK Acres	POLK %	A-3 BERTELSEN Acres	A-3 BERTELSEN %
RESIDENTIAL - TOTAL	303.9	39.4	8.4	0.8
Low dens. .5 <DU/AC <2.5	-	-	2.3	0.2
Med dens. 2.5 <DU/AC <8.5	254.3	33.0	4.5	0.4
High dens. 8.5 <DU/AC	49.6	6.4	1.6	0.2
COMMERCIAL - TOTAL	341.1	44.3	92.7	8.8
Central business District	226.7	29.6	-	-
Strip (and scattered)	114.4	14.9	92.7	8.8
Shopping Center	-	-	-	-
INDUSTRIAL - TOTAL	65.7	8.5	519.9	49.3
Light (wholesale/warehouse/clean)	32.2	4.2	165.1	22.9
Medium (inside/small scale mfg.) (some pollutants)	33.5	4.3	115.9	11.0
Heavy (major log decks & ponds industy w/pollutants)	-	-	238.9	15.4
PARK - TOTAL	29.6	3.8	19.9	1.9
Institutional	10.7	1.4	-	-
Park	18.9	2.4	19.9	1.9
OPEN - Open Space vacant/undev./ag.	30.5	4.0	414.9	39.3
TOTAL	770.8	100.0	1055.8	100.0

* Computed from Computorized Geographic Data File, Eugene Zoning Map and 1977 aerial photos. These figures are accurate better than ± 5 percent.

TABLE 11

PRIORITY POLLUTANT CATCHMENTS
PHYSIOGRAPHIC CHARACTERISTICS

FEATURE	POLK	BERTELSEN
Area (acres)	771	1056
% W/Stormsewers	100	50
% Streets W/Curbs & Gutters	99	94
% Streets W/Dictch & Swale	1	6
% Impervious	75	35
% Effective Impervious	74-75	32-33
Average Basin Slope (ft/mile)	5.3	8
Population Density (persons/mi^2)	5380	120
Street Density (12 ft lanes/sq mi)	92	27
Detention Storage (acre-ft)	0	20-30 in A-3 15-20 in Log Ponds

TABLE 12

PRIORITY POLLUTANT CATCHMENTS - SOILS DATA

SOIL TYPE	APPROXIMATE PERCENT COVERAGE		HYDROLOGIC SOIL GROUP	EROSION POTENTIAL	PERMEABILITY AT GIVEN DEPTH	INCHES/HOUR	POSITION
	POLK	BERTELSEN					
Coburg silty clay loam	14	50	C	Slight	0-18" 18-53 53-65	.6-2 .2-.6 2-6	Alluvial Terrace
Natroy Clay	<2	23	D	Slight	0-5 5-60	.2-.6 <.06	Terrace Bottom
Malabon Silty Clam Loan	80	3	B	Slight	0-12 12-30 30-60	.6-2 .2-.6 .6-2	Alluvial Terrace
Holcomb Silty Clay Loam	-	8	D	Slight	0-24 24-50 50-60	.6-2 <.06 .06-.6	Terrace Plains
Awbrig Silty Clay Loam	-	8	D	Slight	0-7 7-29 29-60	.6-2 <.06 .06-.2	Alluvial Terrace
Chapman Loam	4	-	B	Slight	0-42 42-50 50-60	.6-2 2-6 6-20	Bottom
Conser Silty Clay Loam	-	2	D	Slight	0-14 14-41 41-60	.6-2 .06-.2 .6-2	Depressions
Pengra Silty Clay Loam	-	<2	D	Moderate	0-21 21-60	.2-.6 <.06	Toe Slope Fans
Willakenzie Clay Loam	-	<2	C	Moderate	0-60	.2-.6	Foothills
Salem Gravely Silty Loam		<2	B	Slight	0-30 30-60	.6-2 >20	Alluvial
Newburg Fine Sandy Loam	2	-	B	Slight	0-60	2-6	Flood Plain
Bashaw Clay	2	-	D	Moderate	0-60	<.06	Depressions
Courtney Gravely Silty Clay	-	<2	D	Slight	0-12 12-24 24-49 49-57	.6-2 <.06 .2-.6 6-20	Terrace Depression

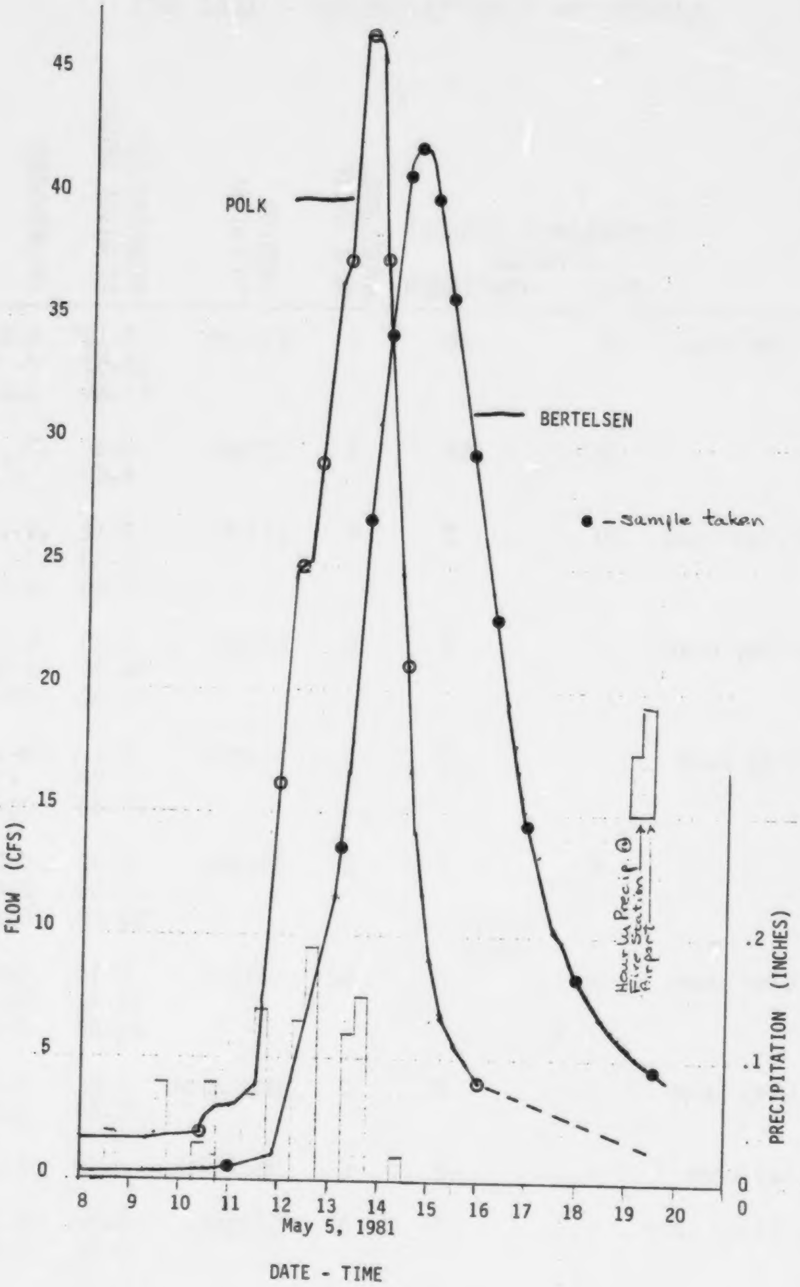


FIGURE 11: PRIORITY POLLUTANT SAMPLING: RAINFALL, RUNOFF AND SAMPLING TIMES
MAY 5, 1981

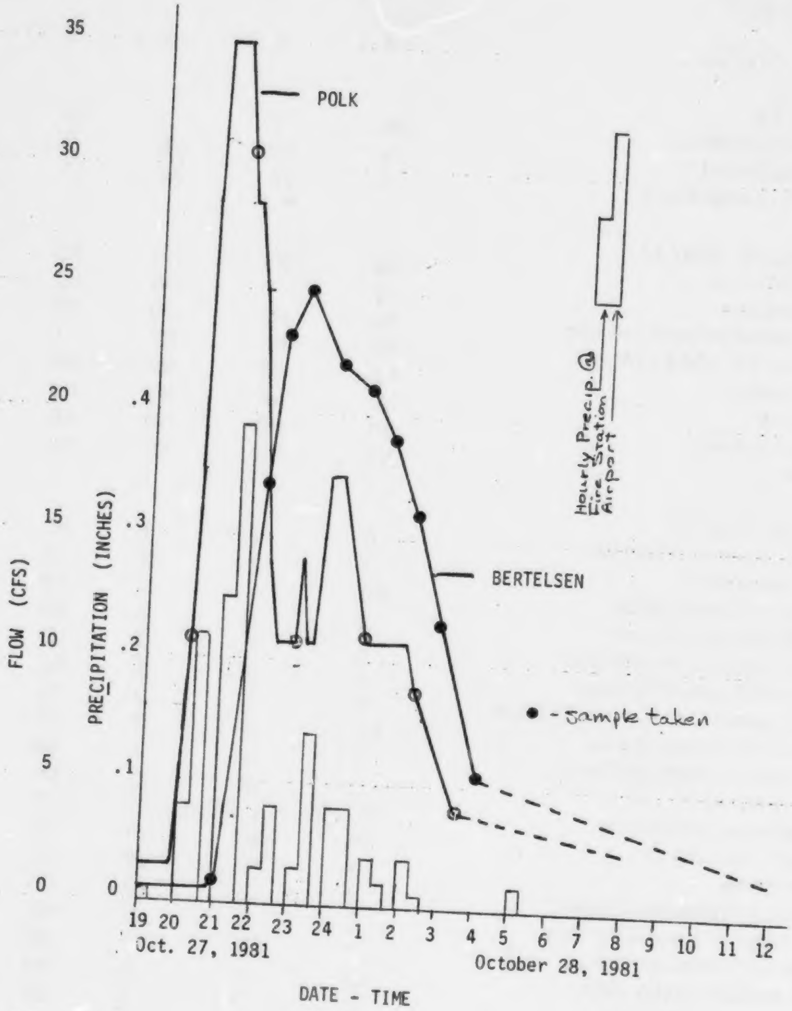


FIGURE 12: PRIORITY POLLUTANT SAMPLING: RAINFALL, RUNOFF AND SAMPLING TIMES
OCTOBER 27 AND 28, 1981

TABLE 13: PRIORITY POLLUTANTS DETECTED IN EUGENE STORM RUNOFF*

Priority Pollutant	May 5, 1981			Oct. 27-28, 1981		
	Polk	A-3	A-3 Rep	Polk	Polk Rep	A-3
Phenols (ug/l)	0.1	0.1	0.1	0.1	0.1	0.1
Cyanides (ug/l)	0.1	0.1	0.1	0.1	0.1	0.1
Acid (ug/l)						
2-chlorophenol	ND	2	2	ND	ND	ND
4-nitrophenol	4	ND	ND	4	ND	ND
pentachlorophenol	4	28	28	11	14	ND
Base/Neutral (ug/l)						
fluoranthene	ND	ND	ND	ND	ND	1
naphthalene	1	1	ND	ND	ND	2
N-nitrosodiphenylamine	ND	ND	ND	ND	ND	4
di-n-octyl phthalate	ND	ND	ND	1	ND	1
anthracene	ND	ND	ND	ND	1	1
fluorene	ND	ND	ND	ND	ND	1
phenanthrene	ND	ND	ND	ND	1	1
pyrene	ND	ND	ND	ND	ND	1
Volatiles (ug/l)						
carbon tetrachloride	2	1	1	ND	ND	ND
chlorobenzene	3	2	3	ND	ND	ND
1,2-dichloroethane	ND	4	4	ND	ND	ND
1,1-dichloroethane	3	2	2	ND	ND	ND
1,1,2-trichloroethane	3	2	2	ND	ND	ND
1,1-dichloroethyiene	4	2	1	ND	ND	ND
1,2-trans-dichloroethylene	3	2	3	ND	ND	ND
1,2-dichloropropane	ND	3	3	ND	ND	ND
1,3-dichloropropylene	2	1	1	ND	ND	ND
Ethylbenzene	2	ND	ND	ND	ND	ND
methylene chloride	Found	In Blank	--	1200	--	--
methyl chloride	ND	ND	ND	ND	81	53
bromoform	1	ND	ND	ND	ND	ND
dichlorobromomethane	2	ND	ND	ND	ND	ND
trichlorofluoromethane	5	2	2	ND	ND	ND
chlorodibromomethane	2	ND	ND	ND	ND	ND
tetrachloroethylene	43	4	5	ND	ND	ND
trichloroethylene	3	3	1	ND	ND	ND
Pesticides	ND	ND	ND	ND	ND	ND

---

* - Excludes pollutants that were detected in similar amounts in blanks and samples

Rep - Replicate

ND - Not detected

Street Sweeping--

Special data needs for the Street Sweeping Pilot Study and included evaluation of weights, size fractions and metal composition of street dirt removed under controlled conditions. These data are published in the Street Sweeping Pilot Study and were not entered into STORET since they are not water quality data.

Sediment Trap--

Two water quality stations were used; one of which was established specifically for the study. In addition to the "above" and "below" ambient water quality, data were also collected on volume of sediment trapped, particle size and sediment distribution. The water quality data are available through STORET, and the sediment data are on file in L-COG. Limited cost data were also generated.

Financial Management Data--

The Financial Management Studies evaluated, in a general manner, the costs associated with various operation and maintenance practices. Since these data were published in three separate reports, they were not tabulated separately or formated for STORET.

Straw Bale Oil Trap--

There were three monitoring stations established to provide water quality data. All the data collected in this mini-pilot study were entered into STORET. Initial plans to do mass analysis of straw bales for oil and grease content had to be abandoned due .to staff time constraints. Much of the pertinent data on this study is included in this Summary Report (Section V, part "Straw Bale Oil Trap").

BACKGROUND WATER QUALITY EVALUATION

Linear Comparisons

In addition to the evaluations available elsewhere in this report, a special effort was made to evaluate progressive changes in water quality on lineal passage through an urban environment. These results are shown in Tables 14, 15, 16, 17 and 18 for the Amazon Channel (and other areas), A-3 Channel (the Bertelsen Slough marsh area), the "Q" Channel for the 1976-78 and 1979-81 periods, and the Willamette River and Polk Street storm sewer sites.

In general, these linear comparisons show background conditions, although in the case of the "Q" Street Channel, some storm conditions are included. Since background conditions are the most common occurrence which affects the various public uses of local urban drainages, these lineal comparisons of background flows are, in some ways, as critical as storm flows. (It is important to remember that few storms occur between May and October.)

In general, some tendency toward degradation can be seen in passage through urban settings but the changes are complex and must be understood in the context of each channel. If flow is diluted, quality will appear to improve, and if there is a significant passage through natural vegetation, general

TABLE 14: AMAZON CREEK AND WEST EUGENE CHANNELS WATER QUALITY - LINEAR COMPARISONS (SAME DATE)*

		n	Flow cfs	COD mg/L	BOD20 mg/L	Total Resid mg/L	Non-Filt Resid mg/L	Con-duc-tance	pH	Alka-linty mg/L	Hard-ness mg/L	NO3-N mg/L	Total PO4-P mg/L	Fecal Colif #/100	Total Iron mg/L	Total Lead ug/L	Total Zinc ug/L	Other: # Found/n (max)
Amazon Channel																		
Amazon Channel @ 29th St. R.M. 12.0	A	7	2.3	9	11.1	180	4	254	7.5	102	105	0.3	0.07	296	1.11	8	3	Limited Data
	M		1.4	8	12.1	175	3	230	7.5	90	92	0.2	0.07	220	0.56	2	7	
Amazon Channel @ Washington R.M. 10.4	A	7	5.5	10	11.5	164	3	235	8.6	91	91	0.1	0.09	550	0.80	3	6	2,4-D (1/1) (0.2 ug/L)
	M		4.5	9	8.6	158	3	211	8.4	82	84	0.1	0.09	62	0.42	3	4	
Amazon Channel @ Oak Patch R.M. 8.5	A	7	6.0	11	16.9	165	5	248	7.7	94	89	0.2	0.10	494	0.92	5	-	2,4-D (1/2) (0.19 ug/L) Mercury (1/7) (0.7 ug/L)
	M		4.5	13	15.4	171	5	255	7.6	97	90	0.1	0.20	320	0.74	5	-	
	M		4.5	13	15.4	171	5	255	7.6	97	90	0.1	0.20	320	0.74	5	-	
Amazon Channel @ Terry St. R.M. 6.0	A	7	14.9	14	10.5	188	18	276	7.4	80	94	0.3	0.07	140	1.12	5	9	Chromium (maximum 18 ug/L) 2,4-D (2/2) (0.4 ug/L)
	M		10.0	14	8.3	170	12	246	7.3	68	82	0.1	0.09	115	1.08	4	8	
Other Channels																		
A-3 Channel @ Bertelsen R.M. 2.4	A	8	2.9	22	14.2	181	8	261	7.1	116	106	0.4	0.21	45	1.50	3	82	Mercury (3/8) (1.2 ug/L)
	M		1.1	22	14.5	186	8	270	7.1	117	106	0.2	0.20	22	1.50	3	83	
A-2 Channel @ Golden Gdn. R.M. 2.5	A	6	3.0	13	10.2	165	8	214	7.2	83	-	2.0	0.30	284	0.66	2	17	Limited Data
	M		0.7	12	11.0	167	4	213	7.3	87	-	2.2	0.31	40	0.52	2	9	

---

* All values are for non-storm conditions for January, February, March, May, July and October 1980, and January 1981. They represent background flow conditions.

A = Average

M = Median

TABLE 15: A-3 CHANNEL ABOVE AND BELOW BERTELSEN SLOUGH (BACKGROUND CONDITIONS - 1978-1981: SAME DATE - 15 DATES*)

		n	Flow cfs	COD mg/L	BOD20 mg/L	Total Resid mg/L	Non-Filt Resid mg/L	Con-duc-tance	pH	Alka-linty mg/L	Hard-ness mg/L	NO3-N mg/L	Total PO4-P mg/L	Fecal Colif #/100	Total Iron mg/L	Total Lead ug/L	Total Zinc ug/L	TOC mg/L	TKN mg/L	O&G mg/L
A-3 @ Wallis R.M. 2.4	A	15	2.8	43	17.7	197	11	269	7.2	119	109	0.51	0.26	205	2.02	6.5	97	20	0.13	5
	M		1.1	27	16.7	196	9	280	7.2	124	119	0.11	0.24	45	1.39	3.7	55	11	0.12	5
A-3 @ Bertel-sen R.M. 3.0	A	15	4.2	25	15.8	178	9	245	7.0	107	88	0.46	0.25	189	2.03	4.2	67	16	0.03	15
	M		1.3	23	15.3	179	7	240	7.1	109	97	0.10	0.21	55	1.51	2.5	30	10	0.01	10
STORM: 15 values, 5 dates** (1980-1981)																				
A-3 @ Wallis R.M. 2.4	A	15	16.3	54	15.2	205	45	186	6.9	77	72	0.49	0.38	3500	2.67	41.0	125	13	11.70	5
	M		5.1	53	7.8	192	12	235	6.8	105	94	0.26	0.36	200	2.50	22.0	90	11	0.01	3
A-3 @ Bertel-sen R.M. 3.0	A	15	22.2	42	11.7	184	38	204	6.9	88	80	0.58	0.28	2713	2.64	18.0	180	13	0.01	8
	M		5.5	35	10.7	185	12	246	6.8	112	98	0.12	0.31	920	2.40	12.0	110	13	-	5

---

* July (2 dates), October 1978; November, December 1979; January, February, March, May, June, July, August, October, November 1980; and January 1981.

** June 1980 (2), June 1980 (4); September 1980 (2); December 1980 (4); March 1981 (3).

A = Average

M = Median

TABLE 16: Q STREET CHANNEL WATER QUALITY - LINEAR COMPARISONS NON-STORM CONDITIONS - 1976-78; 5 DATES - SAME DATE

		n	Flow cfs	COD mg/L	BOD7 mg/L	Total Resid mg/L	Non-Filt Resid mg/L	Con-duc-tance	pH	Alka-inty mg/L	Hard-ness mg/L	NO3-N mg/L	Total PO4-P mg/L	Fecal Colif #/100	Total Iron mg/L	Total Lead ug/L	Total Zinc ug/L	Other: # Found/n (max)
Q @ 2nd St. R.M. 3.2	A	5	2.9	27	5.4	177	8	164	7.7	-	-	1.2	.21	129	-	-	-	See Below
	M		2.0	22	5.9	165	3	160	7.5	-	-	1.0	.19	75	-	-	-	
Q @ Quinalt St. R.M. 2.0	A	5	3.6	25	7.2	145	76	150	8.0	-	-	0.5	.21	122	-	-	-	No Data
	M		3.5	18	7.0	135	11	145	7.9	-	-	0.5	.21	56	-	-	-	
Q @ Skipworth R.M. 0.4	A	5	3.6	13	4.6	141	9	177	7.3	-	-	-	.16	114	-	-	-	No Data
	M		3.5	11	3.1	144	9	182	7.1	-	-	-	.14	13	-	-	-	

---

* Dates include April 1976, January 1977, July 1978 (2 dates) and October 1978; represents primarily low flow.

A = Average

M = Median

TABLE 17: Q STREET CHANNEL WATER QUALITY - LINEAR COMPARISON - 1979-1981; 9 DATES - SAME DATE*

		n	Flow cfs	COD mg/L	BOD20 mg/L	Total Resid mg/L	Non-Filt Resid mg/L	Con-duc-tance	pH	Alka-linty mg/L	Hard-ness mg/L	NO3-N mg/L	Total PO4-P mg/L	Fecal Colif #/100	Total Iron mg/L	Total Lead ug/L	Total Zinc ug/L	Other: # Found/n (max)
South Branch Q @ Mohawk R.M. 4.7	A	9**	5.4	38	20.2	210	27	222	7.4	97	83	0.9	0.38	1045	2.35	118	24	Chromium (4/13) 10 ug/L
	M		2.6	29	18.2	190	6	256	7.5	113	87	0.6	0.27	680	1.01	53	16	
North Branch Q @ Mohawk R.M. 0.3	A	9**	5.7	8	4.2	80	6	95	6.9	36	33	0.4	0.61	11	8.00	-	-	
	M		3.5	7	3.4	74	2	94	7.0	36	31	0.1	0.23	10	4.00	-	-	
Q @ 2nd Street R.M. 3.2	A	9**	18.5	20	13.9	125	19	139	7.3	56	51	0.6	0.14	2280	1.18	81	16	2,4-D (2/4) (0.4 ug/L) 2,4,5-T (2/4) (0.12 ug/L)
	M		9.8	9	12.2	112	6	135	7.1	58	51	0.6	0.12	85	0.58	23	7	
Q @ Garden Way R.M. 1.8	A	9**	28.6	19	19.1	130	19	146	7.0	58	56	1.1	0.16	372	1.36	184	25	2,4-D (2/5) (2.5 ug/L)
	M		13.0	11	16.7	118	10	146	6.9	60	53	1.1	0.12	158	0.82	140	21	
Q @ Skipworth R.M. 0.4	A	7	35.8	14	-	147	13	170	6.9	66	66	1.9	0.14	243	1.22	83	11	No Data
	M		13.0	11	-	146	4	178	6.9	70	71	1.8	0.12	80	0.73	85	10	

---

* Dates include December 1979; January, March and May 1980 (2 values from a May storm), July and October 1980; January 1981.

** Includes 2 samples during a light storm on May 9, 1980.

A = Average

M = Median

TABLE 18: WILLAMETTE RIVER AND POLK STORMSEWER WATER QUALITY - LINEAR COMPARISON 1979-1981
(SAME DATE - 7 DATES; NON-STORM CONDITIONS)*

		n	Flow cfs	COD mg/L	BOD20 mg/L	Total Resid mg/L	Non-Filt Resid mg/L	Con-duc-tance	pH	Alka-linty mg/L	Hard-ness mg/L	NO3-N mg/L	Total PO4-P mg/L	Fecal Colif #/100	Total Iron mg/L	Total Lead ug/L	Total Zinc ug/L	Temp C	Turb FTU
Willamette River @ Sprgfld. R.M. 185.3	A	7	5545	0.6	4.9	59	5	54	7.0	22	19	0.13	0.05	103	-	2.7	5.8	11.0	9.6
	M		4990	0.6	2.8	50	4	55	7.0	22	19	0.10	0.04	7	-	1.5	4.5	9.0	8.0
Willamette River @ Autzen	A	6	6093	0.7	-	65	7	56	7.0	22	19	0.12	0.07	253	-	-	-	10.8	9.9
	M		5175	0.7	-	62	5	53	7.1	22	20	0.11	0.06	125	-	-	-	8.5	7.3
Willamette River @ VRC R.M. 1805	A	7	5545	0.6	15.0	73	6	80	7.1	31	24	0.27	0.06	1045	-	1.9	7.0	11.9	8.0
	M		4990	0.6	12.2	58	4	54	7.3	24	19	0.13	0.05	50	-	2.0	6.0	12.8	4.0
**Polk St. Storm Sewer Discharge R.M. 180.6	A	6	1.8	7.0	18.0	213	7	288	7.3	108	83	1.60	0.16	6710	-	4.0	30.0	16.9	4.1
	M		1.3	4.0	15.0	209	4	308	7.2	107	91	1.80	0.14	3500	-	1.5	26.0	16.2	2.2

---

* Includes non-storm conditions for December 1979, January, March, June, July, October 1980 and January 1981.

** Only 6 dates; excludes June 1980.

A = Average

M = Median

improvement will be noted during most seasons. A few brief descriptions will be illustrative.

Amazon Channel

Table 14 shows same date lineal comparisons for the Amazon system for non-storm conditions but including a significant number of winter, high-background flows. The channel up through Oak Patch Road is heavily populated but receives significant contributions from residential hill areas to the south. The Terry Street monitoring site (immediately below the Danebo vegetation site) is below a major drainage input (in winter) from the Willow Creek Basin. Lineal results are mixed with COD, non-filterable residue, and conductance generally increasing. BOD, alkalinity, hardness, phosporous and coliform tend to drop. The overall impact may be a mixed one of settling and dilution combined with natural treatment, balanced by a tendency to resuspend organic materials previously deposited, plus decayed plant material. The overall view during background conditions is one of an early increase in contaminants (upstream), followed by a stabilization of this load due to opposing forces of input versus dilution and treatment.

A-3 Channel

Table 15 shows an "above" vs. "below" same date comparison for the Bertelsen Slough area. This slough is about 1/3 mile long and about 100-150 years wide, with a narrow center channel that is slow moving but free of cattail that dominate the remainder of the wetland. The bottom oozes are several feet thick and beaver periodically build dams across the entire channel. It takes several hours for flow peaks to pass the slough, and these peaks, depending on size, can either deposit sediments or flush sediments out of the marsh. The data on Table 15 indicated that in storm and background conditions, there tends to be a reduction in loadings on passage through the slough (the Bertelsen site the downstream), although during storms, the dissolved materials (conductance, hardness, nitrate [zinc], alkalinity) tend to increase. These results (or changes) represent a steady state "full slough" situation since the slough is not cleaned or maintained in any way.

"Q" Channel

Looking at Tables 16 and 17, several processes are identifiable. As the Q Channel moves downstream, the quality (for 1976-78, Table 16) as measured by COD, total residue, nitrate, phosphate and other parameters, tends to improve as a result of more dilution, passage through vegetation (marshy) areas, and because most of the intensive urban inputs occur at the upstream end while the lower 1-1/2 miles is open field and park land. Conductance varies in reverse direction due to increasing dissolution of stream sediments.

A similar tendency is seen for more recent data (Table 17) which includes winter high flow values and provides a yearly average picture. It should be mentioned that the north and south branches combine to form the "Q" Channel at 2nd Street and are not linearly related. Again, many parameters drop (BOD, COD, coliform, phosporous) while others associated with processes of dissolution (conductance, hardness, alkalinity, nitrate, etc.) increase. Higher values of some parameters at Garden Way may represent the residual impact of temporary peak storm overflows from a sanitary line that enters between 2nd and Garden Way.

Willamette River

Table 18 indicates a lineal comparison (same date) for the Willamette River in Eugene that focuses on background conditions but with a leaning toward the winter situation. Little change is evident, presumably due to low input from storm channels, but there is a tendency for nearly all parameters to increase slightly.

The data for Polk Street storm sewer is included on this chart since it is the largest direct storm pipe drain in the downtown area. Based on the flows at the concurrent sampling dates (about 5,000:1 dilution), it would not be expected that significant impacts would be detected from this single source. In fact, the Polk Street storm sewer enters below the VRC sampling point and is not included in the ambient river quality at this point.

Worst Values

Finally, Table 19 indicates the worst values for major parameters according to specific monitoring stations. It is from this data that an estimation of the degree of the problem, as well as a key to the "fingerprint" characteristics of each basin can be found. Amazon sites tend to be high in turbidity and residue (erosion sediment), while the A-3 Channel shows a greater impact of industrial areas, plus natural marsh sediments (turbidity, TOC, ammonia, copper). COD's are also high but are overshadowed generally by the oil and grease test site runoffs values.

The Willamette River shows little problem, and the "Q" Channel below the North and South Branch confluence shows BOD and ammonia elevation. The South Branch (industrial area) shows high residue and coliform levels, while the worst category in nearly all organic constituents are observed at the oil and grease trap site, including extreme values for COD, residue, oil and grease, organic carbon and somewhat surprisingly, phosphorous.

The highest coliform levels are found in the Polk Street drainage and on the Q Channel at 2nd Street, both areas where leaking sewer lines are detected. High coliform are not observed on the Q Channel below the overflow structure, since the outfall there is heavily chlorinated.

Statistical summaries of water quality are given in Appendix C.

TABLE 19: WORST PARAMETER VALUES

	TURBIDITY FTU	BOD mg/L	COD mg/L	RESIDUE TOTAL mg/L	RESIDUE NON-FILT. mg/L	OIL & GREASE mg/L	AMMONIA m/L	PHOSPHORUS TTL. mg/L	TOC mg/L	ZINC TTL mg/L	COPPER TTL mg/L	LEAD TTL. mg/L	FECAL COLIF. #/100 ml
Amazon Creek @ Vegetation Site	135 150			345	146 234	41							
Amazon Creek @ Oak Patch	120	39	129	633 377	169,240 180	62		.87					
Amazon Creek @ 29th St. (Sed. Trap)	125 140,300 110	57 36			181 330	51 11			31				
*A-2 @ Golden Gardens								1.35	34				
A-3 @ Bertelsen			148	357		20 10	1.3 2.0 4.5	.73	41	.29			
A-3 @ Wallis St.	135 120	37 41	280		168	8	1.3		31 52	.40	.04(3) .05		
Polk St. Storm Sewer		44	178,138 175 141	419				5.8 .87 .74	31 32 32				80K,85K 75K,68K 35K
*Willamette River below Eugene													
*Willamette River above Springfield													
Springfield Millrace													16K
*"Q" Channel @ Centennial													
"Q" Channel @ Garden Way		40,41 42					1.4 1.6						
"Q" Channel @ Quinalt			150 143	528 424				1.06 .91					
"Q" Channel @ 2nd St.					157 175		3.6				.03	.19	15K 59K,60K 74K
*No. "Q" Channel @ Mohawk	120												
*So. "Q" Channel near Marcola Rd.	125 140,300 110		170	429 590		37	1.3 2.7,5.0 3.0	.99 .75	77		.04(2) .05 .08	.20	
Marcola Rd. Oil Trap			351- 935 10 values	1110- 4100 10 values		45-158 8 values		1.6-2.2 10 values		.31- .65 8 values	.60	.20- .44 8 values	
*72nd St. @ High Banks													

---

* Less than 20 samples

SECTION IV

MODELING

GOALS AND APPLICATION

The NURP Work Plan described the goals of this element as the development of a tool to "determine peak flows, concentration times, pollutant loadings and (to use the) model to evaluate costs and benefits of controls."

Modeling provides an urban jurisdiction with the means to predict situations which are likely to cause problems in the future. The most widely applied use of runoff modeling relates to flow prediction and peak flow estimation for the purpose of storm drainage system design. Closely related to this use is the prediction of sediment production in runoff areas. A third use is the prediction of urban storm pollutant loads, but the techniques associated with this use are less refined, less accurate and more difficult to use.

The City of Eugene had, previous to the NURP Study, limited experience with modeling techniques, primarily in the area of sanitary sewer flows, using the CH2M-Hill proprietary Stormwater Analysis Model (SAM), plus limited design models. The City of Springfield Public Works had no detailed modeling experience and has previously relied on consultants to do basin runoff calibrations. Both cities had participated in a preliminary L-COG storm study which used the STORM-HEC II model to predict long-term increases in basinwide flows and loads.

The purpose of the modeling work program was to develop the local use of modeling techniques as a means of assistance in pursuing an "enhanced water quality" management program. It was felt that local staff familiarity with techniques was more important than the detailed flow modeling of any of the several basins in the metropolitan region. There are two reasons for this assumption:

1. With the exception of one or two hillside streams with potential flooding problems (the Amazon being the most notable), most of the area's channels are overdesigned for reasons of hydraulic grade and are unlikely to flood, considering the low characteristic intensity of rains in the region.

2. Previous modeling efforts have provided estimates of pollutant loads for low stream flow periods during moderate-to-light storms, while the major physical design concern storms are during winter periods when quality problems are minimal (and generally uncontrollable), due to large flushing volumes.

It was hypothesized that the most likely quality benefit of modeling would be to predict sizes and costs for sedimentation basins for design storms, and it was realized that the other uses of modeling would apply only indirectly to water quality enhancement. Specifically, it was felt that the adaption of a modeling program would encourage both cities to deal with urban drainages in comprehensive and integrated manner and hence not allow water quality degradation to persist as the result of a piecemeal management approach. The development of systematic record keeping (necessary to run a model) was seen as the first step in organizing drainage management and in increasing the benefits of a comprehensive drainage utility proposal.

MODEL REVIEW AND SELECTION

In the pursuit of a suitable local modeling approach, the following criteria were considered:

- availability and initial cost
- access
- familiarity
- data needs
- running costs
- accuracy
- applicability to basin planning and system design needs
- versatility and application to open channels

This review process was followed, albeit slowly, in Eugene. In Springfield, because of lesser familiarity with the processes and more limited staff availability, the initial steps involved program support for the developing and cataloging of data into a systematic format for later modeling efforts. The process was delayed in both cities due to budget reductions and other staff time commitments for Eugene.

Although a wide range of the models was screened for potential use, only the following were evaluated in detail:

- SWMM (Storm Water Management Model)
- SAM (Storm Water Analysis Model)
- STORM (HEC) (Storage, Treatment Overflow Runoff Model)

Of these, only the SAM and SWMM models were pursued with any vigor. Although early L-COG work had used the STORM-HEC II, it was felt tht the lack of specific system design features limited its utility from a public works standpoint. The SWMM model has obvious advantages such as accuracy, versatility, completeness and cost of purchase (no charge). The SAM model had the advantages that it was available in a preliminary form (purchased by the City of Eugene for sanitary work), is a more simple model requiring less data and provides an adequate degree of accuracy for design and system analysis, with the potential for expansion to include quality analysis. The SAM model was ultimately selected because of lower data needs and local familiarity. The City of Eugene continued to acquire and document the SWMM model in case the SAM model provide unsatisfactory.

MODELING ACTIVITY AND RESULTS

In order to test SAM thoroughly, the SAM analysis was applied to a recently constructed drainage channel (Roosevelt Channel tributary to A-3) as a check method against the rational design approach. This process was undesirably long since it was found necessary to debug and readjust significant portions of the SAM model, especially those dealing with antecedent conditions of soil moisture. The model was successfully run in late 1981 and was cross-checked against the same data run using an updated version of SAM under contract with CH2M-Hill (see Appendix D for printouts).

This process familiarized Eugene staff with data format needs, organizational and time requirements and resulted in a model in a reasonable state of readiness that has been tested and proven on literature model test data sets.

The modeling capacity of SAM is available with the City of Eugene for potential transfer to the L-COG Research Section, should Springfield decide modeling is an activity with which it wants to proceed. Springfield currently has an updated data file on the storm drainage system, including location and elevation information but the city has been forced to cut back on both staff and services due to a nearly complete drop-off in development activities and the depressed state of the local economy.

FUTURE WORK

Copies of the modeling documentation, as well as sample outputs and digitized computer maps are included in Appendix D. It is clear that a major direction or focus for modeling in this area is predictive runoff work on minor sub-basins (with sizes in the 25 to 300-acre range) as a basis for synthesis of capacity predictions on the larger open channels, most particularly the Amazon and Q Channels and their tributaries. This work will focus on estimation of design concern areas (where reconstruction may be necessary), as well as predictive work based on population and land use scenarios. In particular, the City of Eugene engineering division has included additional budget allocations for development of modeling capacity for the next year. Initial work on the headwaters portions of the Amazon Channel will be completed as the current file information on storm lines is corrected against "as-built" drawings. The entire Amazon Channel is expected to be "model" ready within 1-1/2 years. It is likely that the first detailed work will be on the Willow Creek basin (or tributary to the Amazon) where concerns with flooding and the need to design a drainage system that can protect wetlands containing endangered plant species (Aster curtis, etc.) will require a sophisticated approach.

Because the current model does not have the capacity to do quality prediction, the City of Eugene will rely on practical experience and the results of the NURP Study for guidance in the inclusion of these elements into a basic management plan. This should not prove overly restrictive since the current data provides a good range of estimation for identifying major water pollution loads, and since, because of a combination of factors, including the pilot study results, it is unlikely that either city will need to design detention basins more precisely or allocate costs more diversely than is necessary for simple flow control. Other elements of the study have identified industrial land use areas, as well as the major pollutional concerns (spills), both of which require a non-modeling design orientation. In particular, the "Urban Stormwater Financial Management Studies" (KCM and Dornbusch and Co., Inc., 1971) attached, for each city provide descriptions of "water quality enhancement programs" more detailed than would be available from predictive modeling of water quality, since neither "first flush" flows nor high intensity rainfall hours are of critical concern in this area.

Modeling for quality in the Pacific Northwest appears more useful as a candidate tool for integrating a wide variety of basin concerns and overall system design than for predictive pollution control device installation. This is perhaps best visualized by reference to Figure 2, showing the Amazon Basin. A key element is the realization that upstream activities have impacts on considerably removed downstream beneficial uses, and more importantly, that modeling may be useful in tying administration of an entire system to relevant systemwide criteria and goals. This is even more critically true in Springfield where the ultimate receiving water for the Q Street Channel is Alton Baker Park, a major urban riverine park system. It is only when these drainage systems are identified as complete units and when points of constraint and concern regarding flood control have been identified and dealt with, that a rational basis will exist for specific quality control structures and integrated basin planning.

The current SAM modeling system is able to provide the necessary level of design accuracy for Eugene and can be readily adapted for use in Springfield. It is expected that, particularly in Eugene, this work will proceed throughout the next year until an Amazon System design is completed.

SECTION V

MANAGEMENT PILOT STUDIES

VEGETATION MANAGEMENT

Aquatic vegetation in marsh and pond environments has been tested and successfully used for water quality treatment in a number of situations, but vegetative growth in open drainage channels has commonly been viewed primarily as an obstacle to flood control. While willows can grow quickly and clog a channel, most non-woody plants have only minimal or gradual impacts on flood channel capacity in the Pacific Northwest. Plant growth occurs during summer, opposite the time of flood capacity needs (during major winter storms) and the soft tissue plants break down and are washed away before channel capacity is taxed. Since channel vegetation doesn't necessarily conflict with drainage requirements, we decided to examine the water quality benefits that could be derived from managing vegetation.

Cattails (Typha latifolia) naturally invade the shallow low gradient channels of the Eugene and Springfield area. Cattails are fast growing, highly productive and easily harvested so they were selected as the target species of the vegetation management pilot study. There have been several other management and production studies of cattails in the United States that could be referenced for comparison and various research studies have indicated that cattails provide a natural treatment for sewage wastes.

Objectives

There were four main objectives to the study:

- Determine what water quality improvements occur as runoff passes through a vegetated channel.
- Determine whether harvest of cattails is a feasible and cost-effective means of removing nutrients and metals from urban runoff.
- Determine whether cattail growth or nutrient uptake could be enhanced by dispersing the low summer flows across the cattail beds (which are normally a few inches above water).
- Prepare recommendations to Public Works Departments for managing channel vegetation for water quality benefits.

Findings and Conclusions

Details of the vegetation study are published in a separate report entitled "Control of Urban Runoff Pollutants Through Vegetation Management" (attached). A related biological study of macroinvertebrates and periphyton (algae which are attached to surfaces) as indicators of water quality are reported in the "Biological Reconnaissance of an Urban Drainage System" (attached). Both studies were carried out on the same reach of the Amazon Channel. A brief summary of findings is provided here. Study findings and conclusions are reproduced in Appendix E.

A 2,000-foot section of Amazon Channel near Danebo Road was selected for the study because it was downstream of existing urban runoff sources and contained extensive cattail growth. The study was conducted over a single eight month growth cycle.

The study indicated that naturally vegetated open channels do serve to improve water quality during summer in a number of ways. The study site contained several plant species and although cattails were dominant in the shallow and dry areas, improvements could not be attributed to cattails alone. In general, the water was clean enough to support a variety of fish, invertebrates and periphyton and attracted wildlife to the study site, while a cement lined section of the channel upstream was clogged with only filimenton algae.

A twice-per-year harvesting schedule proved to be detrimental to cattail production and crops of succeeding years. It was also found that regrowth was only successful if plants were harvested from above the water line. These findings were supported by studies elsewhere. It was concluded however, that a single yearly fall harvest would not be detrimental to successive years of cattail growth. The overall benefits of cattail harvest are limited because most of the annual pollutant load occurs in winter and it has not been determined how much of this load remains in the channel sediment. Cattail tissue appeared to contain a significant portion of the nitrogen and phosphorus from summer runoff, but heavy metal concentrations were insignificant compared with the yearly load. Hand harvesting is feasible but tedious and labor intensive. One drawback to harvesting was that channel design currently precludes machine access to the channel base. Level cattail bed surfaces would also have improved management potential.

The benefits of nutrient removal from harvesting would probably be limited in the Amazon system because of the lack of nutrient-related problems downstream (especially during winter). The study did not provide enough data to determine whether flow dispersion and submerging cattail plant bases increased growth, nutrient uptake or sedimentation. It was found that the cattails could not grow in water deeper than 18 inches and this fact restricts the dispersion design.

It was concluded that channel maintenance programs should view wetland plant species such as cattails, bullrush and grasses as beneficial to water quality and useful for recreation, aesthetic and fish and wildlife purposes. The cost effectiveness for cattail harvest could not be adequately determined by this study but harvest was not recommended because there does not appear to be a significant need to reduce nutrients in the receiving water (Fern Ridge Reservoir) of the Amazon Channel. Several suggestions were made for modifying current channel dredging practices to minimize costs and avoid large scale destruction of desirable vegetation.

SEDIMENT RETENTION

Objectives/Basis for Selection

Sediment control is a major concern in most urban centers and certainly in all rapidly developing areas. Sediment problems may be associated with street dirt, hillside erosion, soil failures, sheet erosion, and bank and channel erosion. Sediment is a major concern primarily because its impact on physical systems through such processes as clogging of drains and channels, filling-in of ponds and increased flooding through decreases of channel capacity. Sediment control is also critical in terms of preserving the original land surface. Water quality concerns with sediment generation may be related to destruction of fish habitat or through induced vegetation and algae growth. Sediment also reduces the clarity and aesthetic quality of water and in some soils, deposited sediments may exert an oxygen demand or release nutrients or toxic chemicals back into the water.

Because of a strong national and NURP concern over sediments and their impact on water quality, sediment control was made a pilot evaluation project in the current study. In practice, the concern for sediments in the Eugene and Springfield metropolitan area is primarily related to in-filling of channels and unaesthetic turbidity during peak flows. There is significantly less concern for the direct quality impacts of sediment since the combination of heavy clay soils, low intensity rainfall (a 2-year 1-hour intensity of 0.5 inches per hour) and light and infrequent summer rains (average June-September rainfall is 3.18 inches) tends to reduce the amount of sediment in runoff and to concentrate sediment production in the winter when flows are high and impacts less noticeable.

The decision to test in-channel sediment trap devices stems from the desire to reduce downstream sediment accumulations as well as the original presumption that an appropriately designed trap might produce improved water quality, even during low sediment background and summer "freshet" flows. Reduced channel dredging would be beneficial because this practice creates extreme channel disturbance and severe short-term water quality problems during the low-flow summer season.

Sediment Trap Study

The Sediment Trap Study as carried out is described in more detail in the "Sediment Control Pilot Study Subreport" (attached) and a discussion of both initial and final specific objectives is included. Study conclusions are reproduced in Appendix E.

In brief, a single small site on the upper Amazon Creek in Eugene was selected, and quality and sediment accumulation was monitored over an 11-month period from October 1980 to September 1981. The trap was less than optimal due to problems associated with uncontrolled storm inputs, access and existing structural configurations.

The trap demonstrated a 12 percent volume capture of solids and the potential for low-cost maintenance, but quality data did not demonstrate a positive impact. The bulk of sediment removal was concentrated in the sizes greater than .452 millimeter in diameter, and the bulk of this material was transported (as bedload) during a single major winter storm.

The evaluation of the cost-effectivenesses of in-channel sediment trapping is discussed in more detail in the subreport. In general, it appears that small traps with volume capacity of less than one-half minute at peak flow can be recommended in high sediment production areas if downstream accumulation of sediments poses problems and should not be installed with the expectation of water quality benefits.

Observations and Conclusions

Based on the results of the sediment trap pilot study, as well as other work on downstream vegetation management, the limited installation of sediment traps has been recommended to the City of Eugene. Three trap sites on the Amazon Channel have been suggested, but other sites should be considered in all hillside development areas. The major benefits of these traps would be in reducing the requirements for periodic downstream dredging maintenance. This reduction of downstream dredging frequency would have three benefits: lower yearly cost, reduction of water quality problems associated with dredging and less frequent disturbance of the natural marsh system and its ability to enhance water quality.

Problems associated with installation of sedimentation traps relate to aesthetics, design, location, and construction costs. Potential methods for funding such projects (capital and O&M costs) are identified in the Financial Management Program Reports (KCM and Dornbusch and Co., Inc., 1981) prepared separately.

Because of a generally flat topography, clay soils and the apparently adequate size of most existing flood channels, sedimentation appears to be a lesser problem in Springfield, and so specific projects have not been recommended. Nonetheless, the recommendations for financial management of storm runoff for Springfield provide an identified mechanism for funding the construction and maintenance of such devices. Work with the City of Springfield will focus on the trapping of floating materials, spill isolation and aeration.

STREET SWEEPING

A pilot sweeping program was conducted in Springfield, Oregon in September 1980. The pilot test focused on estimation of removal efficiencies under normal operating procedures on streets with different traffic densities. This study is detailed in the previously published L-COG report, "Street Sweeping Pilot Study -- Springfield-Eugene, Oregon" (January 1982). Study findings and recommendations are included in Appendix E.

Basis for Selection

Street sweeping was selected as a pilot study for several related reasons. Streets are known to contain significant loads of sediment, as well as quantities of trash, litter, organic material, nutrients and toxic metals. Since public works programs currently operate street cleaning programs primarily for aesthetic reasons, it was felt that practical demonstration of the optimum configuration for a sweeping program would provide incentives to expand the program for water quality benefits. In addition, there was some local concern that local air quality was being degraded through re-endrainment of street particulates and that a cooperative test program with the local air pollution authority would shed light on the benefits to be derived in this area as well. In the light of considerable variation in national data regarding the effectiveness of street sweeping, it was felt that local demonstration of this BMP would reinforce the public works quality control efforts.

Objectives

The primary objectives of the street sweeping were as follows:

- Determine the sediment load on local commercial streets under local conditions
- Determine the efficiency of removal of current programs
- Determine the build-up rates during summer dry weather conditions
- Test to see if build-up and removal varies significantly with traffic density
- Determine the fraction of street particulates that are categorized as "re-endrainable" and determine their removal efficiency
- Investigate the concentrations of heavy metals in various size fractions of street dirt

The results of the above investigations were to be used to redefine current street sweeping programs for the benefit of reduced pollutant loads to receiving waters.

Observations and Discussion

The results of the Street Sweeping Pilot Study are discussed in detail in the published report and will only be summarized here. The study showed that the current program utilizing a regenerative air sweeper on commercial streets at a rate of three times a week was nearly optimum from an efficiency standpoint. The study demonstrated that the largest fraction of materials occurred in the 63-417 micron diameter range, but that even the very fine particles of less than 63 microns in size constituted a significant fraction (15-25 percent) of the load. All particle size ranges were removed at efficiencies of 60-85 percent.

The study demonstrated significant load variation between heavily trafficked and connector streets but showed that base loads were very similar in all cases (base load is that load not removed with a single pass of the sweeper). This result leads to the conclusion that frequency of sweeping should be based on traffic load as well as other factors such as land use.

The study also showed that significant loads of lead and zinc occur in street dirt, particularly in the small and medium size fractions. The study did not investigate the direct contributions of street dirt sediment to water quality violations since this complex evaluation is being investigated elsewhere.

Finally, the study lent particular support to the idea that street sweeping has benefits other than those related to aesthetics and provides a basis for support for this activity from service charges or other sources.

This last conclusion is particularly important since street programs are often viewed as "soft" programs with few practical benefits during tight budget times. The indication that both air and water quality benefit significantly from sweeping, should provide support for these management practices. Unfortunately, cost factors identified in the financial management studies for Eugene and Springfield show street maintenance to be relatively costly due to expensive equipment needs and high service and maintenance levels. As a result, street cleaning program expansions rated only a moderate-to-low priority in terms of overall management cost effectiveness. This factor will tend to limit the expansion of such programs.

Future Actions

Although it appears that current practices in both Eugene and Springfield approximate the optimum cleaning program for central business districts, refinement and formalization of the goals and funding sources for this program remains a serious need. Each city needs to review its current cleaning patterns to see if any areas of high traffic density are currently neglected.

Proposals have been made for establishment of storm utility fees, and if established, some portion of these charges should be allocated to this important program. In lieu of service charges, this report should be used by the cities to allocate budgetary funds toward sweeping/vacuuming programs.

STRAW BALE OIL TRAP

A straw bale oil trap test as a method of control of industrial runoffs in a heavy logging and paper products industrial area in Springfield, Oregon was designed and installed but only partially completed.

Basis for Selection

Previous work on urban and industrial pollution in the Eugene-Springfield area identified industrial site non-point runoff as a major source of urban pollution ("Upper Willamette River Basin - Industrial Wastes Study," L-COG, 1978). Subsequent monitoring results have verified that the worst water quality is generally found in channels and streams where the drainage contains a high percentage of industrial lands. These industrial areas are often in areas where drainage comes directly from uncontrolled sites to roadside ditches and then to the existing stream channels. Maintenance of drainage facilities is not generally included in city code requirements. Pollution in these areas tends to be high in organic contaminants, nutrients, color and turbidity. These areas tend to have the highest frequency of chemical accidents and uncontrolled spills, if only because this is the only sector of the community that regularly handles large quantities of toxic chemicals.

Several sites were investigated before a site was selected at the corner of 28th Street and Marcola Road in Springfield, immediately downstream from cedar post and charcoal factories. The factors that went into site selection included the following:

- An open channel with flows during most of the wet season
- Easy access to public works vehicles

- Representative of industrial conditions of areas within the metropolitan area

The site, as originally selected, was at the location of an existing pond which had been inadvertantly converted to an oil trap by means of a partly crushed drainage pipe (creating a subsurface syphon). This original site was moved 20 meters upstream when it was not possible to secure a construction permit because of buried utilities.

Objectives

The objectives for this pilot study were straightforward.

1. Investigate the amount of oil and grease being produced from a particular industrial area
2. Install an oil and grease filter trap and test its effectiveness in terms of water quality
3. Develop design and construction criteria for such runoff control devices
4. Estimate the costs of such industrial runoff management approaches
5. Familiarize public works staff with the practical problems, as well as need associated with industrial site runoff control
6. Develop guidelines for the installation and maintenance of such traps in open channels, roadside ditches and other industrial areas

Study Design

The initial trap design called for a coarse gravel gabion structure located in mid channel of a roadside drainage ditch that would be capable of stopping sediments and filtering significant quantities of oil and grease.

As a result of discussions with the NURP project leadership of the Environmental Protection Agency, as well as consideration regarding construction and cost of materials, this design was altered from the use of a rock gabion to the use of straw bales in a angle iron frame. Straw bales are plentiful in the area and have been used in other situations to contain and soak up oil spills. The changes in design produced a structure shown in Figure 13.

The initial design envisioned a single trap structure located on the #1 Channel (see Figure 14) since this was the channel with an observed steady flow and a history of high oil runoffs.

Following the first storms, it was observed that under conditions of heavy rainfall, a significant amount of oil was running overland and entering via the #2 channel. At this point it was decided to add the second straw bale trap structure and the final configuration is shown in Figure 14. Because of reduced flows and later start-up, less monitoring data was accumulated at the #2 site. Installation of site #2 occurred at the time of the straw bale replacement in site #1 (late January 1981).

FIGURE 13
Straw Bale Oil Trap

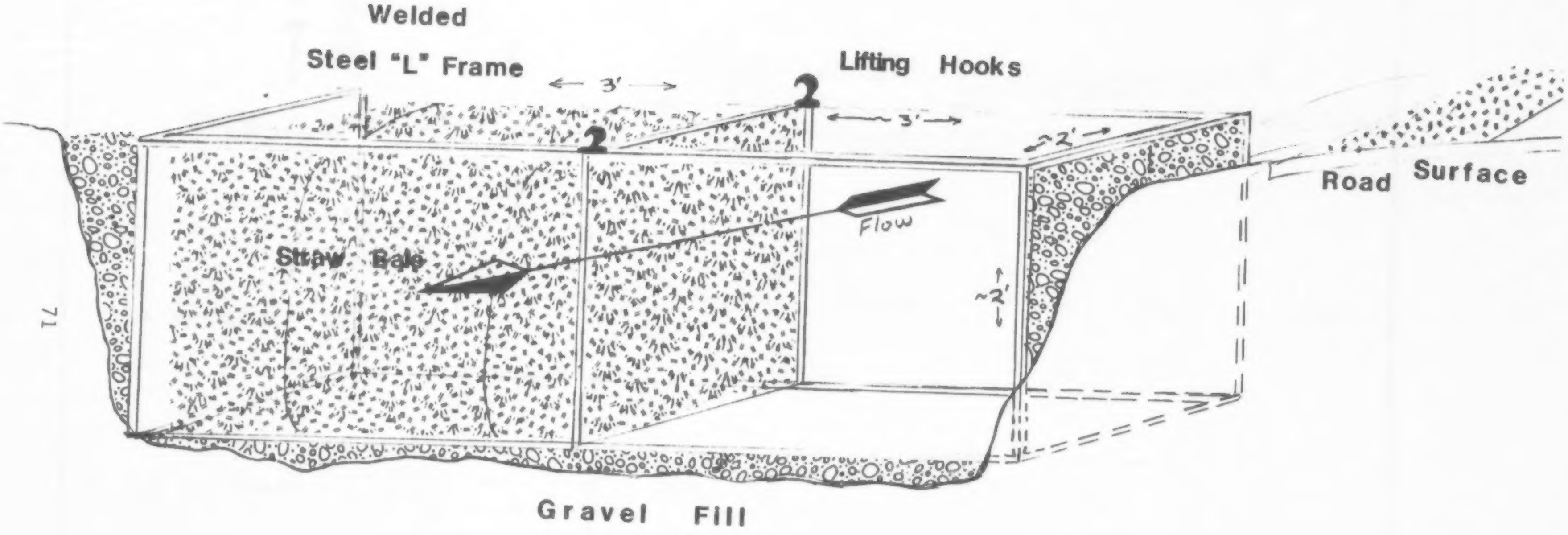
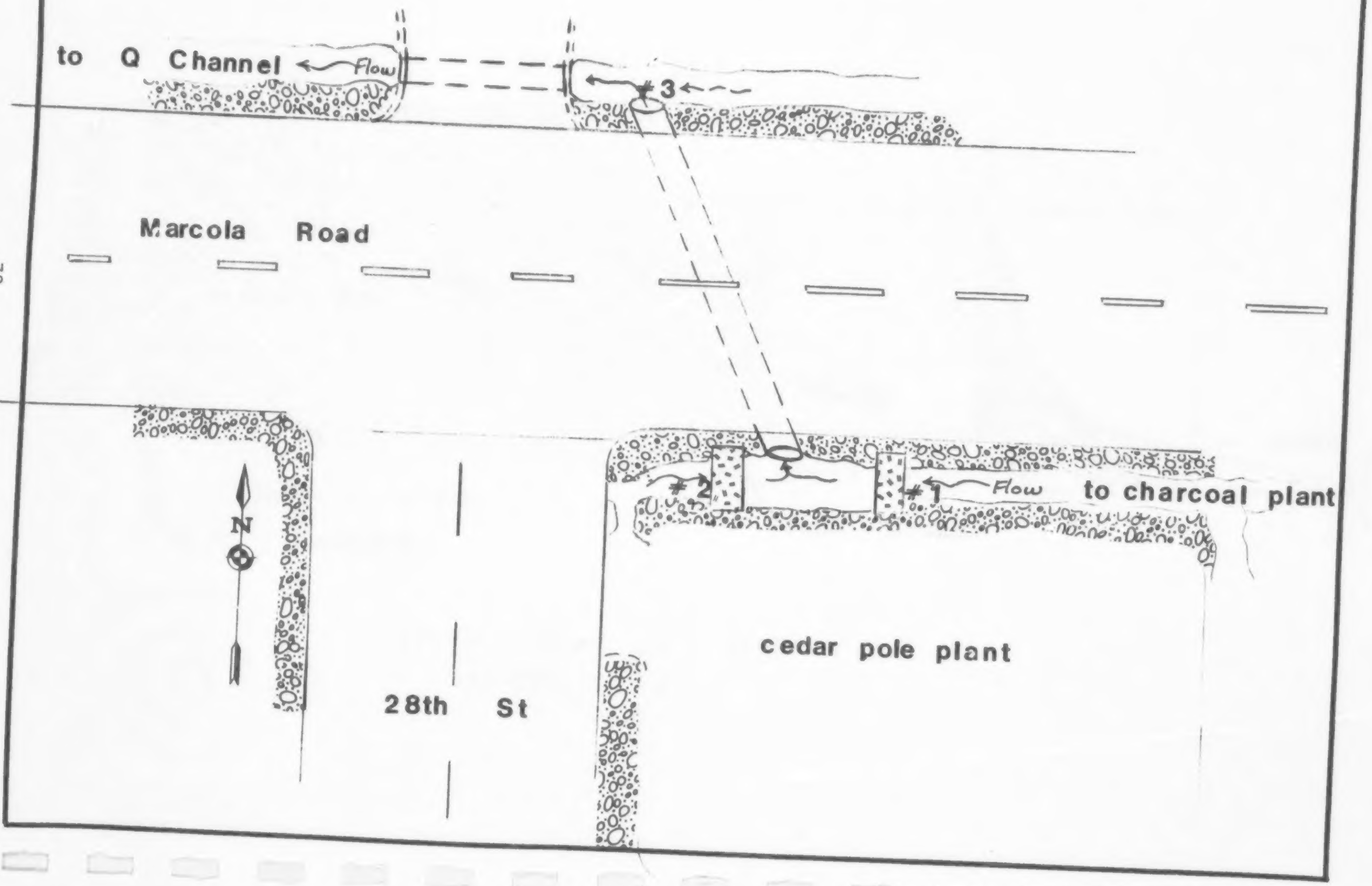

Welded
Steel "L" Frame
← 3' →
Lifting Hooks
← 3' →
~2'
~2'
Straw Bale
Flow
Road Surface
Gravel Fill

FIGURE 14
Straw Bale Oil Trap


to Q Channel
Flow
#3
Marcola Road
#2
#1
Flow
to charcoal plant
N
cedar pole plant
28th St

Monitoring was scheduled for the winter of 1980/81 and focused primarily on storm condition monitoring with analysis primarily for the following parameters:

- Conductance
- Oil and Grease
- Total Residue
- Total Zinc
- Phosphorous
- Total Iron
- Total Lead
- $NO_2 + NO_3 - N$
- COD
- Total Zinc

Samples were taken above both influent arms and below the combined flow discharge. Flows were measured approximately using a velocity meter and standard circular pipe discharge curves for the road culvert.

Trap Installation and Operation

The oil and grease trap was installed in early November 1980 and was operated from mid-November 1980 through March 1981.

Trap installation was relatively simple and involved the work of a public works crew with a back hoe to clean a small portion of each ditch and lower the steel box into the excavated area. The channel was filled in with gravel around the sides of the box, the bottom of the channel was leveled with gravel and two straw bales were placed in each steel box. Installation time took approximately two-person days.

Maintenance included only the replacement of saturated straw bales in January 1981 and the occasional repair of the channel sides to prevent leakage around the bale traps.

Water quality sampling was carried out for a total of 13 samples, including 4 storm events and 3 background situations on upstream site #1 and the downstream site #3. More limited sampling was carried out on Site #2.

After the roadside channel dried up in April, the traps were removed and the bales were stored for potential oil concentration analysis. This analysis was not performed due to staff time and laboratory budget constraints.

Observations and Discussion

Visual observations of the straw bales showed an apparent effectiveness in the accumulation of oil and grease on and behind the bales, giving allowance for some channelization that occurred around the edges and through the middle of the straw bale trap. By the time for mid winter bale removal, both bales at trap #1 appeared to be oil soaked through much of their interior, as well as being water logged.

Water Quality--

The visual observations of effectiveness were not substantiated by the water quality data as shown in Table 20. The data in Table 20 are inconclusive and not particularly encouraging. In order to interpret this data it must be remembered that flows were very low except during peak storms. Flows at the #1 and #3 sites were in the 0.01-0.02 cfs. range, except during storms when flows of up to 0.5 cfs. may have occurred. Flows at the site #2 were generally only 10 percent of those at #1, except during storms when the effect of a great deal of parking lot and road runoff caused peaks equal to those at site #1. The existence of hydraulic backwaters, as well as channel realignments (caused by heavy trucks making wide turns) made accurate and consistent flow measurements quite difficult.

The data indicates that reductions in conductance and oil and grease may have occurred but were not consistent. These reductions were not reflected in the COD or solids data where increases appear to occur. In the case of solids and COD, there is some evidence that the increases were caused by sampling techniques below the culvert, which due to the shallow water layer over a thick mass of accumulated solids, may have resulted more in a sampling of the preaccumulations of sediments than of the trap flow.

Data for nutrients, iron, lead and zinc show no specific trend except that ranges of values tend to be wide and overlapping.

The most observable feature of the data is that industrial site runoffs are indeed a major source of a wide range of urban runoff contaminants, particularly including oil and grease, solids, organic chemicals, phosphorous and iron. Concentrations of these contaminants are 10 to 100 times that found generally in urban runoff in this area.

Visual Observations--

As noted above, the hay bales visually appeared to be effective in stopping and absorbing oil and grease and when removed, appeared to contain significant amounts. The major apparent problem was the absorption of water and the tendency of the bales to start rotting when left in the water for more than two months.

Some difficulties were encountered with flow channelization between the bales, which was easily altered by wedging a block of metal or wood into the straw. Gravel filling around the bottoms and sides was necessary to prevent storm bypass.

Maintenance (removal and replacement) of the site proved to be quite simple, with the use of a back hoe to lift the bales out and easy manual replacement. Removal operations did cause a surge of materials through the empty cage and would indicate the need for some flow barrier during maintenance operations. Some problems occurred with removal due to sagging of the bale and breakage of the baling wire. This could be easily alleviated by the inclusion of a wire strap or yoke at time of installation.

TABLE 20: OIL TRAP PILOT STUDY WATER QUALITY DATA*

	Conductance Micro Mhos	COD mg/L	Total Residue mg/L	Settleable Residue mg/L	Oil & Grease mg/L	Nitrogen NO + NO mg/L	Iron Total mg/L	Lead Total mg/L	Zinc Total mg/L	Phosphorus Total mg/L
11/21/80 Storm										
**#1	68	820	1321	0.1	-	0.54	-	-	-	7.03
#2	-	-	-	-	-	-	-	-	-	-
#3	67	790	1419	0.2	8.9	0.54	-	-	-	2.03
1/6/81 Background										
#1	308	315	555	0.7	19.0	2.13	14.3	.200	.368	1.36
#2	-	-	-	-	-	-	-	-	-	-
#3	302	403	701	21.0	6.8	1.76	10.7	.021	.218	2.19
1/21/81 Storm										
#1	108	441	914	-	86.0	1.50	11.8	.120	.173	1.28
#2	-	-	-	-	-	-	-	-	-	-
#3	153	284	429	0.1	22.0	1.50	11.0	.110	.170	0.75
1/27/81 Storm										
#1	198	1180	2274	-	158.0	-	49.4	.100	.580	-
#2	27 -	935	1286	-	20.0	-	13.5	.270	.221	-
#3	194	1430	2754	-	3.0	-	54.0	.130	.054	-
2/13/81 Storm										
#1	148	-	-	-	56.0	1.00	13.0	.170	.210	1.20
#2	35	-	-	-	45.0	1.00	17.0	.400	.250	1.60
#3	104	-	-	-	67.0	1.00	22.0	.350	.310	1.80
3/17/81 Background										
#1	229	-	499	0.1	10.0	0.73	12.3	.031	.171	-
#2	-	-	-	-	-	-	-	-	-	-
#3	239	-	4099?	14.0	16.0	0.41	-	-	-	-
3/31/81 Storm										
#1	104	349	550	0.02	13.0	0.37	12.6	.102	.190	0.87
#2	27	478	982	20.0	12.0	1.15	14.8	.440	.280	1.68
#3	98	346	612	.16	36.0	0.57	14.6	.190	.280	1.11

---

* Data represent 7 out of 12 samples on 7 dates and include peak storm conditions.

** Because #1 and #3 are the most similar in flow, these "before" and "after" sites are the most readily comparable.

Maintenance was scheduled when physical observation indicated that bales were saturated and beginning to decompose. In the marine climate of the Pacific Northwest, it was found that rotting of the straw began within about 30 days and that replacement of bales was necessary every one to two months.

Costs--

As indicated above, the costs of construction, operation and maintenance of such a straw bale site are low. Table 21 indicates relevant costs.

Conclusions

Several tentative conclusions can be made in regard to the Straw Bale Oil Trap BMP. These conclusions are to some degree speculative and represent an effort to assess the potential useability of such a device under installation and site conditions considered to be closer to optimum than the current situation.

1. Oil and grease, solids and dissolved organic materials can be produced in high concentrations in industrial site runoff where heavy vehicle usage is common. These materials occur in concentrations 10 to 100 times greater than most urban commercial and residential runoffs.
2. The Straw Bale Oil Trap, as tested, did not appear to be particularly effective at removing pollutants, but this inefficiency was apparently the result of inadequate site design control and faulty sampling techniques.
3. Straw bale oil and grease devices appear to accumulate significant quantities of oil and grease, but this benefit is limited in areas where constant exposure to water leads to straw saturation.
4. Construction, installation and maintenance of steel cage straw bale traps for industrial drainage areas appears to be simple, rapid and relatively cheap. Site installation for less than $400 is possible, with tri-yearly maintenance cost adding an additional $405 to the effort for a double trap site.
5. Additional beneficial design features would include a cable yoke to remove the bales without breaking and an upstream (temporary) barrier to prevent pollutant surges during maintenance.
6. Since flow through straw bales is somewhat limited, sites should be chosen carefully so that average flow per bale during a storm does not exceed filtration capacity (about 0.01-0.10 cfs. per bale).
7. Disposal of straw bales is not a particular problem with either drying and incineration or landfill disposal as options.
8. Straw bales are very cheap (in most areas) and hence, permit frequent maintenance. Frequent replacement appears to be necessary to prevent oil or water saturation.

TABLE 21: OIL TRAP PILOT STUDY
STRAW BALE TRAP COSTS*

Item	Quantity	Materials	Labor @ Rate	Total
Steel Bale Frames	2	$35 each		$ 70
Fabrication	1.5		$110/Day	165
Straw Bales	4	$ 2.50 each		10
Channel Preparation & Installation:				
- Personnel	1		$110/Day	110
- Equipment	0.5		$ 30/Day	15
SUBTOTAL				$370
Maintenance/Bale Change:				
- Personnel	1		$110/Day	$110
- Equipment	0.5		$ 30/Day	15
- Bales	4	$ 2.50 each		10
SUBTOTAL				$135
TOTAL COSTS				$505

---

* Costs are estimates based on real costs plus average rates of charge-out.

NOTE: Bale disposal included in maintenance costs.

9. The use of fixed site BMP's for the control of site-specific industrial runoffs would appear to be desirable in order to control runoffs from heavy vehicle use areas. Straw bale absorbers do not appear to be a universal panacea but should be considered with other alternatives because of their low cost and easy maintenance.

10. More testing of small channel and industrial site filtration devices is needed to clarify the benefits to water quality.

SECTION VI

FINANCIAL MANAGEMENT/IMPLEMENTATION

OBJECTIVES

The objectives of this portion of the Urban Storm Runoff Management Program are summarized in Section I of the "Metropolitan Area Summary - Urban Stormwater Runoff Financial Management Program for the Eugene/Springfield Metropolitan Area" (September 1981), produced by L-COG and Kramer, Chin & Mayo, Inc. and David Dornbusch and Co., Inc.

It was realized from the outset that effective control of urban runoff, and concurrently, the effective protection and development of urban channel uses, would be dependent on several factors, including public interest and concern, the identification of best management techniques, prioritization of control efforts and the development of a method for allocation of revenues (and hence, program efforts) toward specific activities. Since the control of urban runoff is largely a daily affair involving operation and management of a variety of systems ranging from channel maintenance to modeling to street sweeping, it is realized the monies have to be directed toward those agencies or groups that are responsible and capable of providing this O&M work.

The Financial Management Work Task was designed to evaluate current costs, evaluate future revenue needs and revenue allocation to urban runoff control activities and recommend a means of generating those revenues and accomplishing the necessary activities. In addition to the Metropolitan Area Summary mentioned above, the following specific reports were prepared for each city:

- "Urban Stormwater Runoff Financial Management Program for the City of Eugene," September 1981, Kramer, Chin and Mayo, David Dornbusch and Co., Inc., and L-COG

- "Urban Stormwater Runoff Financial Management Program for the City of Springfield," September 1981, Kramer, Chin & Mayo, David Dornbusch and Co., Inc., and L-COG

ORDINANCE REVIEW

In addition to the preparation of a financial management plan for both cities, it was also realized that a review, and perhaps revision, of ordinances dealing with pollution and runoff was necessary. This work was intended to be preliminary to and included in subsequent financial management recommendations since it was realized that certain development ordinances generate significant revenues and provide incentives or penalties for certain maintenance and control activities.

Several reviews of existing ordinances were done and a special research effort produced the working document "Design Factors for Storm Drainage and Erosion Control in Eugene and Springfield," October 1980, Markowski, L-COG (Appendix F). Most of this material was reviewed and included in the "Urban

Stormwater Financial Management" report series (KCM; Dornbusch and Co., Inc.), which summarized the existing ordinance situation.

Additional work has been performed by L-COG on industrial site management ordinances (draft Industrial Site Drainage and Pollution Ordinance) and is included separately in Appendix F.

To summarize the results of ordinance research briefly, it appears that both cities have sufficient policies and goals necessary to adequately control most common nuisance aspects of trash, litter and waste dumping. Adequate mechanisms also exist to permit the cities to establish a financing program capable of reinforcing important aspects of these ordinance controls. Most current problems are the result of a lack of enforcement and not the lack of ordinance authority.

However, several areas have been identified where additional work is desirable and this work can be described in several categories:

- Sediment Track-Out

  Neither city has an operative sediment track-out ordinance even though excessive track-out situations can be dealt with under nuisance and litter provisions. The establishment of a track-out ordinance (currently under development) is more critical in Eugene where a greater proportion of development occurs in hill slope areas. In neither city is erosion a major water quality problem compared with other aspects of urban runoff, and major concerns may relate primarily to dust control and air quality.

- Ticketing Authority

  Although there is some discussion of the desire to give building inspectors and certain other Public Works maintenance personnel the authority to ticket violations of litter, runoff or other water related ordinances, there is currently no direct action being taken to define the need for this authority or to pursue it. Work (research) is needed on the legal constraints and practical problems associated with such action. Since the development of a policing authority is only one enforcement option (along with more inspectors, tighter permit control and non-financial abatement orders), with significant surrounding political controversy, no specific recommendation for its implementation are included in the report.

- Industrial Site Controls

  Industrial site management and raw materials storage and handling is an aspect of pollution control first identified as important in the L-COG 1978 "Industrial Wastes Survey." Existing ordinances do not exist in either Eugene or Springfield to address the special hazards associated with these wastes. Monitoring (the Oil and Grease Trap Pilot Study) has verified that runoff from industrial sites has special concerns regarding dissolved organics, residue, oil and grease, nutrients and some metals.

  Recommendations for expansion of current commercial maintenance activities regarding site management are included in the "Urban

Stormwater Financial Management" reports (Chapters 4.2.7 and 4.2.8) and detail, particularly, needs for parking lot maintenance and drainage site planning. Special spill control installations are recommended where hazardous material storage is involved.

Additional recommendations are included in the draft Industrial Drainage and Pollution Ordinance (Appendix F). The major recommendations for industrial site management include the following:

- Expansion of current site maintenance requirements applicable to commercial developments to include industrial park area parking and vehicle use areas
- Requirements for drainage plan development and peak runoff control on all new industrial site developments
- Expansion of ordinance requirements for an approved drainage plan to all existing heavy industrial sites
- Requirements for a raw material storage and handling plan for all heavy industrial sites, specifically including runoff discharge limits to receiving storm drainages when not superceded by existing state permits
- Identification of industrial site "Best Management Practices" by the cities, including track out controls, peak flow control, direct runoff prevention and special spill/oil control devices, where appropriate

FINANCIAL EVALUATION OF BMP'S

During the course of the study, cost evaluations of various BMP's were made as part of the pilot study process. Evaluations included in these subreports are the following:

- "Sediment Trap Pilot Study" subreport
- "Control of Urban Runoff Pollutants Through Vegetation Management"

The evaluation of the costs associated with additional management practices was included in the "Urban Stormwater Financial Management Program" reports (KCM; Dornbusch and Co., Inc.) for each city. The "Executive Summaries" of these reports are reproduced in Appendix F. The reports estimated the current level of effort for each water quality or runoff control activity and projected these costs for a situation of "enhanced" operation of BMP's. Using a subjective evaluation of implementation potential, BMP's were also priority ranked for each city. The BMP's evaluated by this process included the following:

- Street sanitation (sweeping)
- Street maintenance
- Storm sewer catch basin cleaning

- Detention/retention basins
- Development and construction controls
- Channel and vegetation maintenance
- Industrial/commercial site management
- Spill prevention/response
- Storm sewer maintenance
- Capital improvement planning
- Monitoring
- Public information

The resultant priority listings (Tables 4.1E and 4.1S) are reproduced here and the description of the scope of each "enhanced management program" and attendant costs is included in each appropriate report.

It is interesting to note that priority appears to depend more on cost than on water quality benefit. It is also worth noting that recent study results from the Street Sweeping and Sediment Trap pilot studies, would invert the water quality benefits associated with these activities (this was not anticipated from other national studies) but the priority ranking in Eugene would change only slightly as a result of cost comparisons.

In Springfield, detention basins are also considered as a potential spill control device and hence, have a relatively high priority. In the case of Springfield, the recommendation of the formation of a storm utility included the recommendation for adoption of the top five priority water quality items and an estimation of their specific service charge costs (see Table 22).

CONSULTANT ACTIVITY

As noted previously, much of the work in this section of the Urban Runoff Study was performed under special service contracts with consultants Markowski; KCM; and Dornbusch and Co., Inc. In particular, work performed by KCM and Dornbusch and Co., Inc. was completed in September 1981. This work included the "Metropolitan Area Summary" report, which provides a general and extrapolatable summary of the processes necessary to form a solid funding base for storm runoff quality enhancement activities. This report also includes discussion of practical methods used to evaluate costs of programs and allocate monies to those programs. The specific reports for each city (referenced previously) detail the implementation process and the costs.

RESULTS

The "Urban Runoff Financial Management" program reports for each city contain a detailed outline of steps necessary for the formation of a drainage utility and the actual implementation of service charges. This evaluation includes an estimation of regulatory requirements.

TABLE 4.1E

POTENTIAL WATER QUALITY ENHANCEMENT ACTIVITY

Activity	Relative[a] Cost	Relative Benefit to Water Quality	Implement. Potential	Suggested Priority
1. Street Sanitation	2	Med	High	9
2. Street Maintenance	NA[b]	Low	Med	11
3. Storm Sewer Catch Basins	2	High	Med-Low	8
4. Detention/Retention Basins	NA[b]	Med-High	Med-Low	7
5. Development and Construction Controls and Monitoring	7	Low	Med	10
6. Channel and Vegetation Maintenance	1	Low-Med	Med-High	12
7. Industrial/Commercial Site Management	8	Med	Med	4
8. Enhanced Spill Prevention/Response	9	High	High	2
9. Storm Sewer Maintenance	10	Low	High	6
10. Capital Improvement Planning	8	Med-Low	High	5
11. Monitoring Program	9	High	High	1
12. Public Information Program	10	Med	Med-High	3

---

a. Scale: 10 = Low
1 = High

b. NA = non applicable -- cost either could not be determined or was incorporated in one of the other activities.

TABLE 4.1S
POTENTIAL WATER QUALITY ENHANCEMENT ACTIVITY

Activity	Relative[a] Cost	Relative Benefit to Water Quality	Implement. Potential	Suggested Priority
1. Street sanitation	2	High-Med	Med-Low	8
2. Street maintenance	NA[b]	Low	High	9
3. Storm sewer catch basins	1	High-Med	Med-Low	10
4. Detention/retention basins	NA[b]	High	Med	5
5. Development and construction controls and monitoring	7	Med	High-Med	6
6. Channel and vegetation maintenance	3	Med	Med-Low	11
7. Industrial/commercial site management	8	High-Med	Med	3
8. Enhanced spill prevention/-response	8	High	High	1
9. Storm sewer maintenance	10	Med-Low	Med	7
10. Capital improvement planning	3	Med-Low	Med	12
11. Monitoring program	9	Med	Med	4
12. Public information program	9	Med	High	2

[a] Scale: 1 = High
10 = Low

[b] NA = non applicable. Cost either could not be determined or was incorporated into another activity.

TABLE 22

REVENUE REQUIREMENTS
(1981-82 FISCAL YEAR)

CURRENT SERVICES	COST
Maintain 100 miles of pipe, 3400 manholes and 3900 catch basins (Subsurface Drainage)	$ 89,000
Maintain 75 miles of roadside ditches and 18 miles of cross-country ditches (Surface Drainage)	49,500
Weed and Brush Control	23,500
Sweep and Flush Streets (Improved Street Maintenance)	40,500
Unimproved Street Maintenance	5,500
Plan Review Activities	4,000
Building Code Enforcement (Plumbing and Mechanical Safety)	22,000
Zoning Code Enforcement	7,000
City Code Enforcement	9,500
Maintain Vehicles and Equipment	11,000
Maintain Buildings	9,500
Billing	8,000
Subtotal	$279,000
Administration (18.6%)	51.900
Total	$330,900
ENHANCEMENT SERVICE	
Spill Prevention	$ 21,000
Public Information	8,000
Industrial/Commercial Site Management	28,000
Monitoring	9,000
Detention/Retention	2,000
Development and Construction Controls and Monitoring	34,000
Subtotal	$102,000
Administration (18.6%)	19,000
Total	$121,000
GRAND TOTAL	$451,900
TOTAL REVENUE REQUIREMENTS	$451,900

As indicated briefly in a previous section, the results of the Financial Management Work Task are primarily in the area of consideration of utility financing. Springfield has developed its utility proposal to the level of a specific recommendation for service charge implementation and allocation of revenues. A public hearing on this proposal was held on November 16, 1981, with a decision by the City Council to delay implementation until after a thorough review of all development charges in the city. In practical terms, the proposal was tabled because the deepening recession made it politically unpalatable to add any new charges or taxes in Springfield. At the time of the public hearing, unemployment in the lumber and building industry (the economic base of Springfield) was hovering around 20 percent. The materials pertinent to the Springfield public hearing presentation are included in Appendix F.

In Eugene, the report was taken under consideration in time for the 1982-83 budget planning process. Materials were prepared (in-house) analyzing the utility concept and were presented to the City Manager, but no formal proposal for implementation was made for the 1982-83 period, presumably because much preliminary budget material was already prepared (without projected utility charges) and because the recessionary spiral in Eugene (unemployment around 12 percent) also made the addition of new service charges an undesirable political action. Added to this is the fact that the entire metropolitan area recently (late 1980-early 1981) instituted new and increased service charges ($3.50-$4.00) for regional sanitary sewer service.

The results of the evaluation of regulatory requirements clearly indicated that with notable exceptions in the realm of industrial waste and runoff control, new regulatory authority was not desirable. In fact, recent changes were made in Springfield ordinances ("Code," Chapter 10) regarding drainage control during the current NURP Program which more adequately addressed the possibility of control of peak flows and alternatives for erosion containment. These changes were made with NURP Program review and partially uncorporated changes recommended by L-COG. Regulatory conditions and recommendations are summarized in Chapter 3 of both the Eugene and Springfield reports.

Finally, a draft recommendation was prepared and submitted to each city outlining potentials for ordinance revision and enhancement for controlling industrial runoffs and spills. These recommendations are included in the Appendix F as the draft Industrial Site Drainage and Pollution Ordinance. Because this report was preceded by the "Financial Management" reports (KCM) and came during the later parts of the NURP Program, implementation will be pursued through the general planning functions of L-COG.

Future work on any of the current funding ordinance or runoff water quality management proposals will undoubtably be postponed until the current economic situation changes. With the housing/lumber industry at record lows and with projected layoffs of city personnel of from 10-20 percent of the work force, it is clear that there is little support for the addition of new charges or the expansion of urban services. It is expected that the proposed utility charges will not be acted on until the FY 83-84 budget is developed.

IMPLEMENTATION

The "Financial Management" reports contain detailed utility implementation plans and a stepwise description of set-up processes which are currently being actively considered by Eugene and Springfield. The establishment of a comprehensive and integrated enhanced management program will depend on the development of these runoff-specific revenues. Section IX (EXECUTIVE SUMMARY) of this report contains a "Call to Action" which lists the desired implementation steps at federal, state and local levels. These actions include both general and specific items for consideration and will be forwarded to the appropriate levels. At their May meeting, the Areawide Water Resources Advisory Committee adopted a series of recommendations regarding implementation to be sent to the City Managers of Eugene and Springfield. The recommendations are included in Appendix H and were subsequently considered and forwarded by the L-COG Board of Directors at their meeting on May 27, 1982.

SECTION VII

PUBLIC INVOLVEMENT

Public involvement in the NURP study focused on a workshop for municipal public works employees in Oregon, review and policy and program guidance from the 208 Areawide Advisory Committee and initial efforts to publicize urban runoff through the media. The enhanced programs proposed to Eugene and Springfield strongly recommend specific public awareness and outline public involvement needs.

URBAN RUNOFF WORKSHOP

L-COG's 208 Program organized a mini-workshop for public works officials on ways to improve water quality in urban drainage systems. Speakers from EPA's Nationwide Urban Runoff Program and several northwest cities gave first hand accounts of innovative programs and ongoing research. Many Eugene and Springfield city staff attended, as well as people from throughout the Williamette Valley and Medford. The informal conference featured panels on urban runoff quality planning considerations, flow detension basins, street sweeping, erosion control ordinances, potential vegetation management techniques and methods of financing storm drainage programs. A workshop outline and attendance list are included in Appendix G.

Representatives from Salem described a system of multi-purpose detention basins. These basins reduce and delay peak flows and allow some suspended solids to settle. At low flow, these basins are dry and available for parking lots and ball fields. Salem also has newly adopted ordinances for erosion control and floodplain and hillside construction.

The Portland Metro 208 Program has focused on the flooding problems of a single drainage (Johnson Creek). The proposed project involved a traditional engineering solution to flooding (an open cement channel) and probably will not enhance water quality.

Bellevue, Washington has an innovative storm drainage utility which was instigated by public desire to preserve urban creeks rather than bury them. Regulation, financing and planning through a utility has enabled the City to preserve its creeks and enhance its aesthetic, recreational and fisheries benefits. The utility keeps cost down by requiring on-site detention ponds in developing areas and by acquiring additional regional detention basins. The resulting lower storm flows can be conducted through smaller storm sewers. The Bellevue utility was just beginning to develop a quality enhancement fee collection process. One speaker said that the establishment of a storm drainage utility was the only way to assure the financing needed to plan and maintain efficient storm drainage systems and provide needed water quality control measures. Systems development charges cannot do the job alone because full financing of new public services would be prohibitive. Revenue bonds only have limited application. Without a utility, responsibility for urban runoff is usually scattered throughout city departments. Public involvement was felt to be critical in gaining public backing for a utility. Corvallis recently patterned a utility after the Bellevue system. The utility is functioning smoothly due in large to good public relations and lessons learned from the Bellevue experience.

Attendees were interested in the array of options, experiences and research described during the workshop. Most considered financial management to be the key to establishing water quality measures for urban runoff. Details of the program and attendance are located in Appendix G.

SUMMARY ACTIVITIES OF 208 AREAWIDE ADVISORY COMMITTEE WITH REGARD TO URBAN RUNOFF

L-COG created and restructured a 208 Areawide Advisory Committee in February 1980. This committee has followed the NURP grant activities and urban runoff policy issues during its monthly meetings and through subcommittee meetings. A summary of its activities follows:

March 19, 1980 - 208 AAC Meeting

NURP Program introduced and five areas of potential committee input identified, including designation of "special concern" areas, evaluation of BMP's and related policies, review and recommendation of specific urban runoff implementing ordinances, identifying community goals and public involvement activities and considering general and areawide urban runoff planning policies.

May 7, 1980 - 208 AAC Meeting

NURP supplemental grant request was introduced to the committee. Members suggested field trips to better understand urban runoff issues.

July 9, 1980 - 208 AAC Meeting

A member who works for Eugene Public Works Maintenance Division told of a recent major gasoline spill and two other significant spills of paint and diesel oil. The committee expressed concern about non-storm related pollution incidents. The NURP Work Program was reviewed again, including a discussion of the proposed work program for a consultant study of financial management options. A subcommittee of five members was formed to follow the Financial Management Study.

August 6, 1980 - 208 AAC Meeting

The Financial Management contract with Kramer, Chin and Mayo was announced. The committee discussed public awareness/public information needs for urban runoff and decided that TV public service announcements covering topics such as oil and household toxic waste disposal, where storm drains go, hillside development, care and abuse of drainage channels and construction erosion were the priority concerns. A subcommittee was formed to develop scripts and pursue production. Other public information methods suggested included newspaper feature articles and a local slide show. The committee watched and commented on the NURP slide show and felt a local program would be much more effective.

September 3, 1980 - 208 AAC Meeting

The "Emerald Canal" proposal was discussed in terms of its water quality and flow impacts on the Amazon Channel, Fern Ridge Reservoir and Willamette River. The 208 AAC was particularly concerned that predictable urban runoff impacts be considered and that design include measures to reduce water quality impacts. Subcommittee meetings were scheduled. Selected materials relating to the Emerald Canal are included in Appendix G.

September 10, 1980 - Public Awareness Subcommittee Meeting

Prepared a format for Public Service Announcements (PSA). Suggested an order for presenting topics and assigned script responsibilities for four topics.

October 1, 1980 - 208 AAC Meeting

Further discussion of the Emerald Canal, with recommendations to the Emerald Waterways Citizens Committee.

October 8, 1980 - Public Awareness Subcommittee Meeting

Members brought script ideas and reviewed technical assistance options. TV stations are tied up with Christmas ads, so they decided to pursue filming through Lane Community College.

November 5, 1980 - Financial Management Subcommittee

Reviewed the Consultant Work Program and approved a list of BMP's to consider and a schedule for 208 AAC involvement.

December 10, 1980 - 208 AAC Meeting

Staff gave an overview of the Vegetation Management Pilot Study and the special biological analysis completed at the site. Financial management consultant progress was discussed.

January 14, 1981 - 208 AAC Meeting

Members were given background material on urban runoff potential critical areas in terms of land used, beneficial uses and pollution problems. The committee was concerned about the effect of the size of designated areas on potential action by the Cities. Urban runoff programs and financing were discussed in that context and more information was requested from staff, including written material, a field trip and a slide show.

January 21, 1981 - Financial Management Subcommittee

The subcommittee met with KCM and reviewed consultant progress. It had no conflict with KCM findings.

February 1, 1981 - 208 AAC Field Trip

Two members of the 208 AAC received a guided tour of metro area urban drainages and runoff problems.

February 4, 1981 - 208 AAC Meeting

A slide program of urban drainages and problems was presented. Members discussed criteria for designating "critical areas," and four areas were selected based on significant water uses. Major pollutant sources to those areas were also highlighted (see Appendix G). The 208 AAC reviewed proposed state groundwater policy and became concerned over the proposed definition of non-point sources. The primary concern was whether urban runoff should be considered point (and covered by NPDES permits) or non-point source requiring a new management framework. Another concern was over spill prevention and industrial waste management groundwater effects. Following a major urea-formaldehyde spill in the south branch of the Q Street Channel, the 208 AAC moved to urge L-COG and Springfield staff to approach industries to cooperatively set up a prototype spill containment structure at a major storm drain outfall.

March 4, 1981 - 208 AAC Meeting

The Financial Management Study results and initial response of the Springfield City Council and Eugene Administration and City staff were discussed. The committee basically agreed that a storm utility approach would be more equitable and provide more opportunity for water quality focus than present systems. The committee was also introduced to the draft "EPA 1990 Urban Runoff Strategy."

April 1, 1981 - 208 AAC Meeting

Urban runoff monitoring results showing toxics and pesticides were reported and discussed. The "non-point source" definition was brought up again. The committee asked staff to invite DEQ for the next meeting to discuss it.

May 6, 1981 - 208 AAC Meeting

DEQ staff discussed the proposed non-point source definition with the 208 AAC. Commmittee members discussed its application to urban runoff. An EPA representative pointed out that federal regulations specifically include storm sewers as point sources but have not acted on permit issuance. It was questioned whether major storm drainages qualify as state waters, where water quality standards apply. The DEQ felt that standards did apply but because of a lack of policy had not been enforced. A Non-Point Source Definition Ad-Hoc Subcommittee was set up to respond to the proposed definition. The committee reviewed Eugene- and Springfield-enhanced Water Quality Program recommendations and was pleased with the specificity. It suggested supporting biological monitoring, reducing street weeping frequency to four days per week and greater encouragement of improved infiltration techniques.

May 30, 1981 - Non-Point Source Definition Ad Hoc Committee Meeting

An alternate definition was proposed.

June 3, 1981 - 208 AAC Meeting

The alternate definition was approved by the full committee for recommendation to DEQ. The definition would have storm sewers and septic tanks be point sources, subject to traditional enforcement. This definition was presented to the DEQ and the EQC.

June - July 1981 - 208 AAC Special Meetings

Several special meetings were held to produce input for the County planning needs on water resources. A summary of beneficial use analysis and problem and conflict assessments were made for five major basins, including urban runoff problems and clarification of beneficial use definitions.

October 7, 1981 - 208 AAC Meeting

The grim future of 208 funding was discussed. The 208 AAC moved to set up future goals for L-COG Board consideration. A new radio station volunteered public service time to Springfield, and the 208 AAC revived the Public Awareness Subcommittee to help prepare one on urban runoff.

November 4, 1981 - 208 AAC Meeting

The committee reviewed future water quality planning needs for Lane County and recommended a role for the Areawide Advisory Committee in developing local spill control prevention and response needs.

November 6, 1981 - Public Awareness Subcommittee Meeting

The committee met in Springfield and using the basic script for PSA #2 Oil Disposal (Appendix G), finalized a radio version. Two voices were used and recycling locations were included. (The PSA was aired on KQDQ radio during the week of November 15, 1981.)

January 6, 1982 - 208 AAC Meeting

Urban Runoff Street Sweeping Study results and recommendations were discussed. The status of financial management implementation was discussed. A Springfield public hearing brought out strong concern over a new tax on development. The Eugene Public Works staff is not planning to push for a drainage utility until some other critical city problems are addressed. The need for spill response capability was discussed again in terms of a major gas spill from a highway accident. There is a major need to coordinate with the Fire Department to avoid a "flush it down the drain" response.

February 3, 1982 - 208 AAC Meeting

Urban runoff public information needs were outlined and a new Public Awareness Subcommittee was formed.

March 3, 1982 - 208 AAC Meeting

The Vegetation Management Pilot Study results were presented. Lane Community College again volunteered to give complete TV public service announcements on urban runoff.

March 12, 1982 - Public Awareness Subcommittee Meeting

The committee met with the Lane Community College Student Supervisor and made extensive suggestions and recommendations for public service announcements. Lane Community College was to respond in April during Spring Term.

May 5, 1982 - 208 AAC Meeting

Urban runoff recommendations were reviewed and modified, and staff was asked to revise them, submit them to subcommittee review and present recommendations to L-COG to go to Eugene and Springfield.

May 20, 1982 - Public Awareness Subcommittee Meeting

A script and visual back-up for a 30-second TV PSA were completed by LCC students. The committee reviewed and commented on the script, feeling it would achieve the objectives of PSA #1 (Appendix G). Filming was scheduled for June 1982 and committee members were to help arrange the audio part.

SECTION VIII

IMPACT ASSESSMENT

There are two levels of impact assessment to consider. The first relates to the impact of the current situation regarding runoff pollution, and the second relates to the changes or impacts of adopting program recommendations that would reduce non-point urban pollution.

SOCIAL IMPACTS

Current Impacts

The current impacts of urban runoff pollution and related problems in the open drainage channels have three aspects: (1) recreational use, (2) aesthetics and (3) public safety.

Current water quality causes reduction in recreational use for several reasons, including unsafe bacterial levels, unaesthetic conditions and concerns with safety from trash, garbage, etc. Since in many situations the existing water courses and drainageways are surrounded by parks and bikeways because of cheapness and availability of land, floodplain restrictions, water use, etc., the situation of lowered recreational potential is visibly obvious and would be severe but for the fact that the worst pollutant loadings occur in mid-winter when use is low.

Because of the degraded quality of water in channels and the currently inadequate planning and maintenance, few of the waterways in the parks are actually designed to enhance recreation. The Amazon flows through Amazon Park but is only incidental to the park, and no water-oriented recreation areas have been developed. Alton Baker Park has been developed around water, but contact recreation is excluded because of water quality problems from the "Q" Street Channel. The Eugene Millrace is heavily used by the University community for canoeing but is too contaminated with coliform organisms to permit safe swimming. Most other urban channels are restricted to a physical presence, and the lack of adequate water quality is a major factor controlling design.

Aesthetics are a matter of considerable debate, and some residents no doubt find "constructed, even-sloped" channels to be unaesthetic even if landscaped. Other people will find even concrete channels aesthetic under appropriate circumstances. Currently, aesthetic impacts of existing channels are poor-to-fair, with long reaches of unmaintained vegetation alternated with barren, recently dredged sections. Significant portions of open channels in both Eugene and Springfield are concrete lined and unlandscaped. In addition, trash and litter is removed only infrequently and creates eyesore conditions throughout much of the Amazon and Q Channel systems, Island Park, and to a limited degree, Alton Baker Park. The Eugene Millrace periodically gets sufficiently trashlined (every year or two) to require a special University clean-up project. The accumulation of sediments and the often turbid and brown appearance of the water in these channels also detracts from aesthetic conditions. In particular, the visual impacts caused by unmaintained or recently dredged channels in parks and open spaces tends to encourage a sense of unconcern and lack of identification with the potential uses of the urban waterways. Steep side banks and dense concentrations of brush, even in bikeway corridors, encourages the attitude that the channels are best forgotten and merely a necessary nuisance.

Public safety is currently reduced as a result of poor water quality (bacteria, occasional spills of chemicals and gasoline), as well as the physical hazards of injury from broken glass, debris, rat populations and in a few areas, mosquito breeding. In several past instances, children have been injured while playing on concrete control structures. An unlikely but not remote possibility is the poisoning of members of the public from eating frogs, crappie, bass and other animals that inhabit the lower channel reaches and which may be contaminated by heavy metals or disease organisms. Finally and not least, the lack of appropriate maintenance can lead to flooding and/or erosion during storm events.

Enhanced Management

Recommendations for enhanced management would tend to impact a wide variety of currently negative social impacts, and while the impact on each aspect would not be striking, the overall impact would be generally positive.

Improvement of quality would improve the aesthetics of the channels and make recreation more attractive. In addition, health hazards would tend to be reduced, especially those associated with infections, disease, etc. Appropriate vegetation management could increase flood capacity with only temporary and infrequent negative aesthetic impacts, while general channel maintenance would remove physical hazards and breeding areas for rats and mosquitoes. Sediment traps would reduce the frequency of downstream channel dredging and trash accumulations, thus facilitating channel maintenance. It is necessary that control structures be adequately protected from or designed for recreational use to prevent accidents.

An appropriate channel and vegetation maintenance program could also avoid disruptions to wildlife habitat and improved aesthetics would tend to increase the use and value of parks and bikeways. Reduction of spills, clean-up of streets and tree shading of the stream would provide positive benefits in terms of lowered health hazards from disease or toxic chemicals, reduction in adverse wildlife impacts and lower water temperatures with the concommitment increase in the health of the aquatic community. Improved street cleaning would also benefit local air quality by reduction of particulates.

All of these decreases in negative social impact require, primarily, a recognition of beneficial uses and a definition of a management program to address them, based upon the work in this study. The most difficult aspect of planning to include in these designs relates to flood control since the maximumization of flood capacity (concrete channels, no vegetation, detention basins) may reduce aesthetic potential, and pose safety problems (drownings, mosquitoes, etc.), particularly with the creation of larger water impoundments. Maintenance of high water quality and increases in aesthetics and recreation will require some compromises in flood control design.

ECONOMIC IMPACTS

Current

The current situation represents the lowest cost operation and maintenance scenario but may not result in lowest long-term capital costs. Current channel operations are performed only as necessary, to maintain flood control capacity. Immediate capital costs are deferred by avoidance of detention structures and so forth. However, flow studies indicate that in certain areas (East Springfield and the Amazon Channel), development without attenuation of runoff will result in high capital costs necessary to restructure entire drainage systems.

Nonetheless, the current system represents a low cost balance of operations. Maintenance of banks, trash collection and dredging are deferred until necessary to reduce overflow problems and yearly costs are reduced. In some cases, this proves counterproductive, as in 1981, when dredging maintenance of the upper Amazon Creek stimulated bank erosion which will increase the frequency of maintenance downstream.

Maintenance of channels in Springfield is minimal, with the exception of brush control, using herbicides, which relies on the lowest cost techniques. Spraying is less common in Eugene because of public concern but annual maintenance costs are reduced by scheduling maintenance less frequently.

It is generally true in both Cities that current operations focus on low cost programs, with the transfer of negative impacts from such practices to aesthetic, safety and recreational degradation. Street sweeping is a notable exception since its schedule is primarily determined by aesthetic considerations and only fortuitously concurs with recommended frequencies in commercial areas.

The current economic impacts of spill events and their control cost is hard to gage since neither City spends a significant amount of resource on detection and clean-up, and enforcement costs are often passed on to the State Department of Environmental Quality. Similarly, the costs of the spills are dispersed among all recreational users, fishermen and other citizens and are rarely evaluated or directly passed through to the violator.

Enhanced Management

It is clear from the financial management reports (KCM; Dornbusch and Co., Inc., 1981) that increases in water quality, aesthetics and recreational potential are not without cost. The estimate for Springfield was an annual cost of $1.73 million and for Eugene was $3.12 million. (The actual values proposed by Springfield were somewhat less than this.) The overall charges amount to approximately $36-48 per residence per year. Of these costs, approximately two-thirds would be applied to capital improvements, which are costs that are necessary to maintain and expand current drainage and flood control systems. This information is presented in more detail in the financial plan reports and is a conservative (high) evaluation since some of these costs would be offset by reduction in the use of general revenue funds for drainage and runoff control.

The installation of a service charge system would have long range positive offsetting economic impacts in that capital needs could be planned in a timely manner, and to some extent, inflationary pressures could be negated. Similarly, particularly regarding flooding or personal damage, prevention could reduce disaster costs, lawsuit settlements, etc.

As with the current practice of avoiding costs by transferring the impacts to social values, the increased costs would be, at least in part, transferred to socially perceivable improvement in water quality, aesthetic appeal and potential for recreational use. The question of whether the improvements in water quality and water resource benefits associated with enhanced management are worth the monetary cost associated with them is ultimately a social question that is open ended. The actual improvements achieved depend on the level of funding, as well as the public and agency attitude and attention to the management program. Likewise, the desire of the populace to avoid current negative situations (rats, mosquitoes, hazards to children, infrequent flooding), as well as to increase their use of local water resources for recreation and enjoyment, is indeterminate. It should be noted, however, that there should be a positive disparity on the side of enhanced runoff control in the cost benefit ratio, since the current situation contains current (but hidden in the general fund) costs and deferred penalties (childhood accidents are only important when its your child), while the estimated costs associated with a reduction in hazards and improvement in benefits are overstated and include apparent costs that will be compensated by other reductions (e.g., general fund reductions). It is safe to say that some additional level of cost is more "effective" than the current situation, but the optimum cost will depend specifically on the wishes of the city residents.

ENVIRONMENTAL IMPACTS

Current Impacts

Current local impacts have been noted throughout the report and range from aesthetic problems to reduced recreational access to physical hazards to major fish and wildlife kills, The average situation is one of chronic, moderate pollution and degradation of most urban channels. The physical hazards and aesthetic impacts tend to be the more significant since many of the channels are major focii of parks and bikeways. On the other hand, since contact recreation developments in these parks are avoided in the planning stage, the current impacts on swimming and fishing is only moderate. The poor quality, bacteriologically, of the Eugene Millrace has not been known to prevent University use for canoeing, nor has posting of the Island Park and Alton Baker Park areas totally eliminated swimming in hot weather. The incidences of infection or injury among youngsters playing (exploring) in the channels is not known.

Larger scale impacts have potential in three areas: (1) Fern Ridge, (2) the Main Stem Willamette River and (3) the McKenzie River. Clean lake studies on Fern Ridge show that during spring, summer and fall periods, most pollutants are effectively filtered out of the limited Amazon flow by extensive vegetation areas and reservoir testing has shown little impact from the Amazon flow. During the winter, high flows with loads of sediment, trash and other pollutants reach the reservoir but usually pass through it rapidly, as it is drawn down for flood control at this time. It is not known what the impacts of these loads are on the lower Long Tom or Willamette Rivers, but dilutions by that time is quite high and flushing of the streams tends to be thorough.

Impacts of runoff on the McKenzie River are similarly undetected and presumed small since only a few small residential and industrial drainages reach this basin, and then only after passage through sloughs and marshes that filter and treat pollutants.

The most significant impacts of runoff to receiving waters occur on the Willamette River, although these impacts are not always easy to detect. During certain low water periods, contamination of the Island Park area is a result of runoff in Springfield. During most storms, the Polk Street storm sewer dumps visible and significant oil and sediment loads into the river. The lineal data for the Willamette River reflects only a slight general tendency for water quality to degrade in the metropolitan area (see Lineal Comparison, Section III), but these data are reflective primarily of background conditions and not the critical spring and fall storms. It is likely that much of the urban runoff load contributes serially, in small increments, to increases in bottom deposits and lowers water quality on passage through the metropolitan area. The visual impact of sediment and growth accumulations on the gravels is readily observable. Impacts on dissolved oxygen levels or other water column constituent levels are probably minor due to large river flows and a great deal of reoxygenation through turbulence at rapids (the dilution is probably at least 20-1 at all times). It is not known what impact this incremental degradation has on migrating salmonids, nor is it easy to separate the impact of runoff from that of sewage discharge (in Eugene and Springfield), since this has not been specifically studied. It is likely that increased vegetation growth on gravels makes spawning and rearing less successful below the storm input areas but the degree of this impact has not been quantified.

Enhanced Management

As noted, particularly in the "SOCIAL IMPACTS" section, enhanced management is likely to yield a range of environmental benefits particularly associated with the reduction in catastropic events, such as spills. The major storm channels are currently classified as "moderately" enriched and are quite diversified (see Biological Reconnaissance Report on the Amazon). It is unlikely that even the most vigorous runoff management will reduce by more than 50-60 percent the general pollutant load, and hence, it is unlikely that the entire biotic character will drastically alter. Particularly on the open channels (Amazon, A-2, A-3, Mill Race, "Q"), a program of control would tend to shift populations to less pollutant-tolerant (clean water) species, and reduction of spills would prevent occasional major decimations of the biota. It is unlikely, for example, that Amazon Creek could be converted to a trout stream unless additional water supply is introduced (as in the Emerald Canal proposal). Also, urban channels will continue to violate coliform and sediment standards at times, and oxygen will continue to be dominated by stream temperatures and algae and plant growth, although some of the proposed management practices such as shade tree planting could improve this situation.

In the Willamette River, reduction of storm pollutant loads, through enhanced management, is likely to reduce the accumulation of sediment deposits and growths on bottom rocks, with subsequent improvement of fish habitat.

However, it may be hard to distinguish such benefits from those associated with removal of the Springfield sewage treatment plant effluent, scheduled when the metro regional facility is completed in 1984 or 1985.

Again, since summer runoff is low except during occasional strong storms, urban runoff is of limited impact due to dilution and winter runoffs are flushed rapidly to areas of settling such as Portland harbor. Spills are the most likely urban pollutant source to be dramatically reduced, both in the open channels and the Willamette River. Chronic impacts will be reduced by an effective program, but the benefits to fish and wildlife will be less dramatic or observable than spill control and will be found more in social and aesthetic long-term improvement trends.

OVERALL ASSESSMENT

As noted in previous L-COG urban runoff reports (1977-78), the loading from urban runoff in the Eugene-Springfield metropolitan area is estimated to be 30-50 percent of that from sanitary discharges. These loadings are not directly comparable since sewage loadings are composed of organic materials and "digestible" solids with high oxygen demands, while runoff contains refracticle solids with relatively lower oxygen demand, more trash and higher levels of oil, grease and toxics. It is the conclusion of this study that expenditure of funds proportionate to those for sewage loading reduction (the regional plant alone will cost $105 million, with a 20-year life) are justified for runoff management, particularly when considering the combined social, environmental and aesthetic benefits derived from runoff management and considering these activities can be directly integrated with flood and drainage control efforts. The estimated yearly cost of $5 million areawide (see ECONOMIC IMPACTS section) is reasonable and would seem to be justified by the benefits.

SECTION IX

EXECUTIVE SUMMARY

OVERVIEW

Review of Original Problem Statement

The NURP proposal to EPA listed three necessary components, from a local standpoint:

1. specific monitoring to pinpoint problems;
2. development of implementation and financial tools; and
3. specific information on control techniques.

In addition, the local findings were to be generalized for national data base and technical information needs.

In large measure, these objectives have been accomplished, though not exactly in the manner originally planned. A great deal of water quality and flow data were collected and entered into STORET, and additional data on rainfall, dryfall, priority pollutants, pilot studies and biological system parameters were developed for specific analysis. Fewer storms were monitored than anticipated but more parameters were evaluated, and the detail of analysis was increased in several key locations. With regards to ordinances and financing mechanisms, it was discovered that most necessary ordinance tools were available, but a comprehensive financing scheme was needed. Attention turned toward a storm drainage utility proposal with special water quality allotments as a means of enhancing the ability of each city to deal with urban runoff problems. The financial plan cost detail permitted the systemwide proportioning of costs by activity and obviated the need for extensive cost evaluation of individual management practices.

The time constraints of inherent in one-to-two year pilot field studies precluded achieving steady state or optimum design and meant that many pilot study results were inconclusive. These studies did, however, fairly evaluate several management techniques and indicated the constraints on implementation even though optimum results were not achieved.

Finally, special efforts were taken to ensure the transferability of the current study results to the NURP as a whole, through STORET entry (9,773 pieces of data over 44 parameters at 25 stations for 1-1/2 years), and provision of a fixed site data base for monitoring basins. Particular efforts were made to adapt the financing planning and technical investigations for nationwide consumption by publication of a special financial overview report plus four technical pilot study reports.

Overall Assessment of Problem

It was found that the problems associated with urban runoff are often sufficiently serious to affect channel and receiving water uses (swimming closures, fish kills, aesthetic enjoyment), and represent a chronic nuisance problem. Problems are seldom easy to isolate or definitively describe and usually require "non-point" solutions. For example, oil contamination is fairly common and can range from very serious spills to minimal wash-off from equipment yards, while color, turbidity, sediment, bacteria and trash problems are nearly universal in occurrence but vary in impact, depending on the beneficial uses of receiving water. Sediment may have little impact in a marsh, and trash may be effectively hidden, but in a park pond are unacceptable. These pollutants come from the entire range of urban sources, including homes, streets, commercial and industrial areas, illegal dumping and physical occurrences such as floods. The solutions often require intensive maintenance and source investigation and will vary from season to season and year to year.

Industrial areas are generally the worst runoff polluters, with low density residential areas being the cleanest. However, many of the problems from industrial sites are associated with specific "events," while residential runoff tends to follow seasonal patterns. Each basin appears to show its own unique "fingerprints" that depend in part on land use, and in part on the specific industries, businesses or residential mix and habits of the area. It is difficult to generalize, but some obvious correlations are noted:

- Sediment is associated with hill areas and areas with higher road densities and construction activity.
- Oil and grease are associated, in heavier doses, with truck use and repair areas, as well as oil refining or processing sites.
- Coliform organisms (in their highest concentrations) are associated primarily with leaky sanitary lines, but generally high levels are found in most residential areas.
- Organic and biochemical oxygen demands may come, either from accumulations of old vegetation (stagnant marshes) or high oil, grease, sewage and chemical spill loadings.
- Heavy metals (lead, zinc) are associated primarily with special industrial processing areas and street materials.
- Nitrate loadings are found to be generally low, as might be expected from the highly leached soils in the area, but phosphorus levels usually are high during storm peaks from unknown (home?) sources.
- The waters in this area are generally low in dissolved minerals and exotic organic pesticides.

Since urban runoff is generally routed to open channels in or around the periphery of the metro area, many of the impacts of the urban runoff pollution are absorbed (and mitigated) by the natural biological, chemical and physical processes of these open drainage channels. These natural processes are often the best line of defense against chronic or background pollution, such as the normal summer contamination in the Amazon Channel. However, natural biological systems may be destroyed by serious chemical spills and bypassed or overwhelmed by flood events. It becomes a matter of assessing the uses of each water area and addressing clean up goals at specific concerns rather than applying a blanket and citywide project approach. In most local areas, for example, the impacts of excessive sediment transport are slight and unnoticed, while fish kills from chemicals and reduction of swimability in receiving streams are more critical.

It is important to remember that because of seasonability of rainfall, impacts and flow are only marginally correlated. The winter peak flows are 1,000 times greater than summer lows and may contain 60-90 percent of the yearly pollutant loading. However, the impact of the remaining 10-40 percent of loading may be more dramatic if it interferes with a summer use such as boating or swimming.

In summation, urban runoff poses chronic problems of varying severity, with the degree of concern related more strongly to use than to absolute chemical quality in most cases. Spills are a particular and unpredictable problem that occasionally overshadows all other concerns. Pollution reduction to achieve general stream standards will be difficult since some water degradation is inherent in passage through an urban setting. It would appear prudent to set conservative or general abatement goals rather than absolute standards.

In the Eugene-Springfield area, water quality problems would appear to be at the low end of the national urban spectrum, with beneficial use values being reduced but rarely eliminated. Limited but significant clean-up of non-point urban pollution is possible, using known techniques and a commitment to redirect financial resources. Public awareness or conviction regarding the importance of local water resources is critical to an effective implementation of modest (30-50 percent) target reductions in current pollutant loadings.

STUDY OBJECTIVES - RESULTS ACHIEVED

Milestones

As part of the original NURP Program and in addition to the general and specific program goals listed elsewhere in this report, the project designated a series of "milestones" for use in evaluating the final program success. These milestones are listed below:

1. Submission of designated critical areas
2. Resolutions of Intent on urban runoff work
3. Adoption of general management objectives
4. Adoption of a hillside runoff ordinance
5. Adoption of an industrial site management ordinance
6. Adoption of construction practices ordinances
7. Critical area protection plans
8. Adoption of drainage management financing plans

9. Summary report

Milestone Outputs

1. Designated Critical Areas

On February 4, 1981, the 208 Areawide Advisory Committee designated four "urban runoff critical impact areas," including the Alton Baker Ponds, Fern Ridge Reservoir, Bertelsen Slough and Island Park on the Willamette River. The Q Street, Amazon and A-3 Channels and downtown Springfield storm sewers were listed as the primary problem sources. The Alton Baker Ponds are at the terminus of the "Q" Channel floodway, Island Park is located at the outfall of the Springfield Millrace, Bertelsen Slough is a direct receiving drainage for a major industrial area and the entire south and west of Eugene drains via Amazon Channel to Fern Ridge.

The adopted Metropolitan Area General Plan, Section C, "Environmental Resources," Policy #1, states that "Springfield, Lane County and Eugene shall consider downstream impacts when planning for...urban runoff, recreation and water quality along the Willamette and McKenzie Rivers." This policy applies particularly to Alton Baker Park and Island Park concern areas. Policy #14 lists specific steps to be taken to improve water quality in these areas and in the metropolitan area in general.

In Section E, "Environmental Design Element," Metropolitan Area General Plan, Policy #2 encourages the retention of natural water features and drainageways. This policy applies at least generally, to Amazon Creek and Bertelsen Slough. The entire Amazon Channel and Q Street Channel, as well as Bertelsen Slough are identified as "Parks and Open Space" on the Metropolitan Area General Plan diagram (see Appendix H). Fern Ridge Reservoir is outside of the jurisdiction of the Metro Plan.

2. Resolutions of Intent on Urban Runoff Work

Resolutions of intent were one of the first items completed in the current study. Eugene, Springfield and Lane County participated in the study and supplied local match funds totaling $65,000. Staff reductions and commitments to other projects reduced the overall commitment from Eugene and Springfield to approximately 65 percent of the anticipated activity.

3. Adoption of General Management Objectives

As noted, this milestone was substantially completed as of October 1979, with the signing of the Work Agreement Contracts by Eugene, Springfield and Lane County. Also, the Metro Plan (referenced in item 1 above) addresses general urban runoff pollution abatement goals in Element C, "Environmental Resources;" Element D, "Waterway" and Element E, "Environmental Design." These elements contain adopted policies on reduction of urban runoff pollution (Element C, policy 1), protection of environmentally sensitive areas (Element C, policy 4), specific treatment measures (Element E, policy 15), hillside and wetland management (Element C, policies 14 and 23 and Element E, policy 2) and waterway development and enhancement (Element D, items 3 and 4). (These elements are reproduced in Appendix H.)

4. Adoption of Hillside Runoff Ordinance

Hillside Erosion Ordinances were reviewed, and it was found that Eugene generally had adequate ordinance capacities. Springfield developed but did not adopt a Hillside Erosion Ordinance but did adopt a revision of Chapter X of the Springfield Code, regarding land division and land development (adopted July 1, 1981), which includes sections on surface drainage (10-4-2); storm drains (10-4-3); grading (Article 5); soils, geology and drainage pollution and erosion (10-5-8 and 10-5-9 [see Appendix H]).

In addition, the Metro Area General Plan (1980) contains a policy (Element C, Policy 14) which "commits local jurisdictions to "develop plans and programs which carefully manage development on hillsides...in order to protect scenic quality, water quality, vegetation and wildlife...." More directly, in Policy 19, the jurisdictions agreed that "Eugene shall maintain and improve and Springfield shall adopt hillside development regulations." It is considered that these satisfy the intent of this milestone.

One result of the analysis of runoff data was to remove sediment and erosion from the list of major water quality concerns in the area. Due to the predominance of fine textured clay soils, the quantities of sediments tend to be low except during extreme runoff events. Other factors such as turbidity, oil, grease and spills have greater impact on water resource uses.

5. Adoption of Industrial Site Management Ordinance

This milestone was not achieved, although significant progress was made. The Financial Management report (Kramer, Chin and Mayo; Dornbusch and Co., Inc. 1981) identified the need, priority and financial and administrative tools necessary to promote industrial site management. In addition, a draft Industrial Site Drainage and Pollution Ordinance has been proposed and is under review by Eugene and Springfield (see Appendix F).

Increased regulations of industrial sites, besides being particularly unpopular under the current economic climate, are dependent on an increased City staff to publicize, interpret and enforce such ordinances. Staff increases would be dependent on the development of additional revenues (storm service charges) and the allocation of resources to this specific purpose. The process of developing recommendations on financial management made it clear that it would be unproductive (and perhaps counterproductive) to propose such programs in the absence of full City support for a drainage utility.

6. Adoption of Construction Practices Ordinances

This milestone was largely achieved through the policies of the Metro Plan and refinements of current ordinances regarding hillside erosion.

Beyond these needs, the Financial Management reports for Eugene and Springfield determined that adequate local ordinance authority currently exists (Chapter 3.2.3-3.2.6 in Eugene and Springfield reports).

7. Critical Area Protection Plans

The critical areas, as identified by the 208 Advisory Committee (see Appendix G), were not approached with singular area protection plans but are dealt with primarily through the adopted Metropolitan Plan policies (see milestone #1 above) and the special pilot study recommendations and financial management procedures developed under other work tasks.

More specifically, the Financial Management report for Springfield (Chapter 4) recommended spill control devices on the "Q" Street floodway in two places and at storm sewer discharges to the Springfield Millrace. Similarly, detention and trash collection sites identified in Springfield focused on the "Q" Channel and the Millrace. Recommendations for maintenance of natural vegetation focused on the downstream portions of the "Q" Channel above Alton Baker Park. The Springfield City Council accepted the Financial Management report in October 1981, and the proposals are still under review for implementation, following a public hearing in which residents voiced concern over adding to current development cost burdens in a period of severe recession.

Similarly, the Eugene Financial Management report recommended industrial spill control primarily on the A-3 Channel (Bertelsen Slough) and vegetation management on the Amazon and A-3 Channels (Chapter 4) in order to protect the Amazon tributary to Fern Ridge. Flood and sediment control devices were proposed primarily on the Amazon Channel, again protecting Fern Ridge Reservoir. This report was accepted by the City of Eugene and is still being considered for adoption in the 1982-83 budget cycle.

The Vegetation Management report and the Sediment Detention subreport also focused on the Amazon Channel. Each of these reports contains specific recommendations for the Amazon Channel. It is worth noting, however, that a Clean Lakes Study of Fern Ridge would tend to indicate that pollutants (sediments, nutrients, etc.) are only of minor impact in Fern Ridge because the reservoir is drawn down for flood control from October through February to less than 10 percent of its summer volume. As a result, much of the urban runoff pollutant load from winter storms apparently flushes through Fern Ridge quite rapidly.

8. Adoption of Drainage Management Financing Plans

The Urban Stormwater Runoff Financial Management Program reports for the Cities of Eugene and Springfield were submitted to Eugene and Springfield staffs and councils during October and November 1981. The plan for Springfield was accepted, and materials were prepared for a public hearing in December 1981 (see Appendix F). As a result of concern over the local economy and current development costs, Springfield postponed adoption until overall development charges could be reviewed and possibly until the economy improves.

Eugene received and discussed the proposed financing plans in December 1981 but postponed active consideration for the 1982-83 budget period. It is not likely that adoption will occur in the face of current budget problems. The proposal is still very much alive but has been sidetracked by the recession in development, as well as commitment of the City to other costly and capital intensive developments, such as a Performing Arts and Convention Center.

The L-COG Board has acknowledged the separate financing reports for Eugene and Springfield, as well as the process-oriented Metropolitan Area Summary report on financing options and recommendations approved by the Areawide Water Resources Committee (Appendix H) will be forwarded to the City Managers.

9. Summary Report

This report, completed in May 1982, is the final milestone for the current NURP Project.

WORK TASK OUTPUTS

Reference in this section should be made to the March 24, 1980 letter on milestones. Each work task output description includes a list of outputs, achievements and failed or incomplete work.

Work Task #1 - Rainfall Data

- Complete listing of hourly rainfall data for 31 years (in Data Base File)
- Tabulation of storm rainfall amounts for two continuous and two partial recording stations during study period; data summary in Appendix A; complete data in Base File
- Correlation of storm event rainfall amounts and intensities for one site in Eugene and two sites in Springfield with the U.S. Weather Bureau station west of Eugene (Appendix A)
- Graphic presentations of rainfall patterns during major storm monitoring periods (1979-81), coupled with runoff amounts (for Amazon Channel; see Section III, Figures 6-9)
- Statistical evaluation of storm volume, duration, intensity and time between storms for the 31-year period of record analysis (SNYOP based on four interevent times [Data Base File and Appendix A])

The overall storm and rainfall data analysis proved satisfactory and sufficient to define the aereal variation in rainfall throughout the Eugene-Springfield area. SYNOP analysis was interesting and appeared to justify the assumption that the statistically significant interevent time of 30 hours is relatively meaningless in the Pacific Northwest. Sufficient data was available to calibrate models and correlate runoff flows.

- Summary of the effect of SYNOP Storm Interevent Times for Eugene/Springfield on storm statistics (Section III, Figure 5)

Work Task #2 - Model Selection

The Storm Analysis Model (SAM), a proprietary model of CH2M-Hill, was chosen for most intensive analysis of modeling. Regarding data inventory, the following outputs are pertinent:

- Fixed Site Data Base, including soils, site location and areas, topographic data and testing methods, support data (rainfall, gaging information) supplied previously to EPA headquarters and on computer file (May 1980) -- also available in Project Data Files
- Digitized urban runoff basins for Eugene and Springfield -- on the Lane County Parcel File -- permits computer-assisted determination and mapping of land use, zoning, soils and area (available in Data Base Files; basin map included in Appendix D)
- Digitized storm discharge points for the City of Eugene greater than 22-inch diameter (in Data Base File and on computer with Eugene Public Works)
- File update of Springfield storm basin structures, elevations and control points (available in Springfield files)

It is anticipated that the digital files and mapping potentials will facilitate modeling of major basins by the City of Eugene, using SAM and this process will be pursued in FY82-83.

Work Task #3 - Data, Monitoring and Inventory

Products include both raw data and analysis results. The following information is available:

- STORET retrieval -- statistical analysis by sites (1975-81; in Appendix C)
- STORET retrieval -- complete data listing for all sites (1975-81; in Data Base File)
- Catalog listings of storm data for Eugene and Springfield (1976-81; Appendix C)
- Lineal comparison water quality analysis (same date samples) for Amazon Channel, A-3, Q Street Channel and Willamette River (1976-81; Section III, Tables 14-18; computer printouts in Data Base File)
- Lineal comparisons for Amazon Channel grouped by "storm" vs. "background" (see Vegetation Management report)
- Table of "Worst Values" - ten worst parameter values arranged for all sites (Section III, Table 19)

- USGS Amazon Channel gage -- hourly stage readings (October 1979-March 1982; in Data File; daily flow records in Appendix B)
- L-COG rating curves for 12 monitoring sites (Appendix B)
- Amazon Channel (@ USGS) flow vs. time vs. rainfall charts for monitored storms (1979-81; Section III, Figures 6-9)
- Quality assurance protocol, test methods, test precision and monitoring schedules (Appendix C)
- Priority pollutants -- see Work Task 11, "Impacts"

All the data from the current and previous studies for the sites of concern to the NURP Study are listed in STORET, and additional analysis is available through that system. Priority pollutant data is not listed in STORET but is available through EPA NURP headquarters.

Work Task #4 - Sediment Trap Cost Benefit

The major output of this task was the Sediment Trap Pilot Study subreport on the Amazon Channel, Eugene, Oregon. The study focused on analysis of sediment and water quality changes at a small in-stream detention device. General performance and cost factors are discussed and recommendations are made in this subreport, as well as in Chapter 4 of the Financial Management Program reports for the Cities of Eugene and Springfield. The site turned out to have several limitations and results were not encouraging for water quality improvement from small sites. Sediment removal to reduce downstream accumulations appeared to be effective for larger particle sizes (specific recommendations are included in Appendix E).

Work Task #5 - Vegetation Management Summary

Available under this element is a separately published report, Control of Urban Runoff Pollutants Through Vegetation Management, a pilot study on the Amazon Channel in Eugene (March 1982). This study evaluates site conditions, water quality changes, cattail management techniques, cattail vegetation growth and tissue characteristics and other biological features. A companion biological survey, Biological Reconnaissance of an Urban Drainage System was printed in March 1982 and covers the same reach of the Amazon. This is described in greater detail under Work Task #11, "Special Impacts."

Cost estimates were very general for the pilot study due to the experimental nature of techniques, but cost analysis for other channel maintenance activities are included in the Financial Management Program for the City of Eugene report. Findings and recommendations on vegetation management are included in this report and in Appendix E.

Work Task #6 - Industrial Site Management

This work task included two separate elements -- monitoring of a pilot study and development of an industrial site management ordinance. The pilot study of a straw bale oil trap was somewhat of a disappointment (results were not conclusive or positive), and a discussion of the effort is included in this Final L-COG NURP report, Section V.

The draft Industrial Site Drainage and Pollution Ordinance is included in Appendix F and has been submitted to the Cities of Eugene and Springfield for review and consideration. This proposed ordinance was developed subsequent to the completion of the financial management proposals (October 1981). Costs of industrial site management enforcement are included as estimates in the Financial Management reports (Chapter 4, "Enhanced Practices" and Appendix A-2, "Detailed Expenditures").

Work Task #7 - Hillside Erosion Ordinance

The work on this ordinance was discussed in the preceding chapter under milestone #4. As noted, Springfield adopted a revised Chapter X of the Springfield Code, "Land Division and Land Development" (July 1, 1981), which included some improvements in requirements for drainage and erosion control (see Appendix H).

The Sediment Trap Pilot Study subreport on the Amazon Channel was also produced as part of this study. This subreport is discussed under Work Task #4. Sediment trapping appears to require fairly large basins for water quality improvement and attention to design is necessary to reduce maintenance costs.

Work Task #8 - Street Maintenance Analysis

The report produced under this work task, Street Sweeping Pilot Study, Springfield-Eugene, Oregon, was published in January 1982 and focuses on an evaluation of current practices from both water and air quality standpoints. The report included recommendations for action which were included in the Financial Management Program reports for Eugene and Springfield (the proposals in the financial management plans were produced somewhat prior to the final street pilot study). A cost evaluation of current practices and estimates for improving practices was also included in the financial analysis. Recommendations are included in Appendix E.

Work Task #9 - Modeling

No specific outputs were predicted for this activity. The Storm Analysis Model (SAM) from CH2M-Hill was debugged and applied to a test basin in Eugene. Results were compared to a rational method analysis, as well as a computer analysis, using a revised, updated SAM model. Results (printouts) are available from Eugene Public Works and selected sections are reproduced in Appendix D.

Theoretical test basins were also cross-compared with the EPA SWMM model, and results appeared to be satisfactory. Eugene Public Works intends to incorporate SAM modeling techniques into flood plain and capital improvements planning on an ongoing basis. These programs will be made available to Springfield but may not be needed until economic growth resumes in the area.

Work Task #10 - Financial Management Planning

The major effort and product on this work task were three companion reports:

- Urban Stormwater Runoff Financial Management Program for the City of Eugene report; Kramer, Chin and Mayo; David Dornbusch and Co., Inc.; L-COG; September 1981
- Urban Stormwater Runoff Financial Management Program for the City of Springfield report; Kramer, Chin and Mayo; David Dornbusch and Co., Inc.; L-COG; September 1981
- Metropolitan Area Summary for Urban Stormwater report; Kramer, Chin and Mayo; David Dornbusch and Co., Inc.; L-COG; September 1981

These reports evaluated ordinances, tabulated current costs, proposed enhanced runoff management programs and recommended a financial management process and funding allocation method to implement enhanced runoff management programs.

The City of Springfield accepted the report, and a financing implementation program was drafted (see Appendix F) and submitted to the City Council at a public hearing on November 16, 1981. Because of concerns over the local economy, as well as expressed need for review of all development-associated charges, the proposal was deferred. The consideration of a service charge is still active in the City and may be included in the next year's budget process.

The City of Eugene was not able to include a utility recommendation in its 1981-82 budget cycle and likewise faces a serious recessionary situation with high unemployment, hence, proposal for the 1982-83 cycle is anticipated but uncertain.

Work Task #10A - Program Recommendations

Many of the general recommendations from the L-COG NURP program to the Oregon Department of Environmental Quality, L-COG Board, or Cities of Eugene and Springfield are discussed later in this section (under "Call for Action"). Special recommendations relating to street sweeping, vegetation management, sediment control and other enhancement activities are included in the technical reports and subreports, as well as in the financial management program (financial plans) recommendations for each city and reproduced in Appendix E.

The Areawide Water Resources Committee approved a series of general recommendations (Appendix H) which were forwarded by the L-COG Board to the City Managers following their May 27th meeting.

Work Task #11 - Special Impacts Monitoring

The following outputs were produced under this work task:

- Biological Reconnaissance of an Urban Drainage System for the Amazon Channel, Eugene, Oregon (March 1982)

- Priority Pollutant Data Listing and Summary for the A-3 Channel and Polk Street Storm Sewer, Eugene, Oregon (complete listing in Data File, Summary in Section III)

The NURP Study identified spill-related problems as a major potential focus of impact studies. Several serious incidents occurred in 1980 and 1981, but staff commitments precluded intensive follow-up. The impacts of a sulfuric acid spill on the Amazon Channel are partially recorded in the Biological Reconnaissance Study (apparent mollusk "scraper" decimation) and in the Vegetation Management Study, where fish kills were noted.

Although original plans called for a joint project with Willamalane Park and Recreation District on the special impacts of runoff on park waterways (Island Park in particular), this effort was abandoned due to Park District budget failures which forced them to curtail all operation, maintenance and planning functions for three months during the scheduled study period (summer of 1980).

Work Task #12 - Public Involvement

These tasks are documented in a separate chapter of this summary report. Major efforts for public involvement included "Urban Runoff Mini-Workshop on Local Public Works Information" (see Appendix G for program) and ongoing review by the 208 Areawide Advisory Committee. Many ideas for increasing public awareness and influencing personal behavior have been examined by the committee, and it is recommended that such programs be a significant element of the "enhanced runoff programs" listed under financial management. The committee assisted Springfield in producing a radio public service announcement (Station KQDQ-AM) that warns against dumping waste oil in storm drains.

Work Task #13 - Program Management

Outputs included 11 quarterly progress reports, as well as the Final L-COG NURP report. Information exchange with other NURP Programs brought a great deal of outside data and reports to the Data File, which are listed in the Bibliography.

CALL FOR ACTION

Action for urban runoff management can be considered at three levels - local, state and federal.

Federal Level Action

Although the federal level of action has been quite silent, the following actions on the federal level would appear to be justified and consistent with the results of the current study:

- Repeal or revise Section 17 PL-95-217 regarding Section 202 of PL-92-500 and Section 36(c) of PL-95-217 regarding Section 211 of PL-92-500, such that facility construction grants are eligible for funding separate storm sewer projects from Section 201 monies

- Establish guidelines for cost effectiveness evaluation of stormwater pollution control activities, limiting such funding to monitoring, financial management and specified types of control construction
- Define national BMP's acceptable for funding
- Suggest that runoff management plans are appropriate for all SMSA's
- Require SEA's to contain identification of basic state policies regarding urban runoff pollution and spill control
- Require SEA's to identify urban runoff management elements for each SMSA in the state, including a statewide priority list for urban pollution control problems
- Publish results and hold workshops in each region on the results of the NURP Study. Efforts should be made to reach all SMSA's, all cities over 100,000, as well as regional planning agencies and state environmental agencies.

The intent of these actions is several:

1. to deal with separate and combined systems separately but to make separate storm systems eligible for federal funding;
2. to establish a consistent federal direction supporting state efforts regarding reduction of runoff pollution, trying not to unduly constrain the states but relying, nonetheless, on the results of the NURP Study;
3. to provide particular incentives to industrial spill and site and storage management;
4. to require that the problem be addressed in all major urban centers on a consistent basis; and
5. to provide technical assistance and advocacy for those state and local agencies with significant urban runoff pollution problems.

State Level Action

The need for state level action will vary from region to region and state to state, yet it is at this level that coordination responsibility rests such that overall basin pollution issues are dealt with. Assuming the federal government will continue to emphasize the responsibilities of state and regional efforts, there are actions that should be taken statewide to guide and assist local jurisdictions in dealing with runoff problems and provide a minimum of consistency. The following recommendations have been suggested to the Oregon Department of Environmental Quality:

1. Develop a statewide policy that includes elements relating to roles and responsibilities of state agencies and municipalities, a thorough definition on non-point sources and criteria standards or guidelines necessary to identify areas of runoff concern (e.g., stream size, uses, population, industries, etc.).

2. The state should establish a general storm runoff permit process geared to system and trouble spot identification, as well as prioritization of need. Such a permit system might be used to identify discharge locations, potential spill areas, listings of current management practices, identification of water standards and beneficial uses, etc.

3. In most areas, there will be a need for state estimation and/or review comparison of urban runoff pollution loads with point source loadings. This information should be in compliance with adopted or proposed facility plans or river basin plans.

4. The state should consider methods for financial and technical assistance related to management practices, construction, maintenance and spill control procedures. Using the prioritization of needs and estimates of proposal costs, states should develop statewide cost/benefit evaluation lists for projects.

The intent of these actions is several: to put the state in an overview role to supervise and coordinate actions by cities and SMSA's, to provide some incentive and assistance to cities in controlling runoff and reducing spill problems, and to provide some measure of consistency in evaluation and treatment of runoff problems by establishing a general permit process. The state would appear to be the logical level for evaluating the relative basinwide impacts of pollutants from non-point and point sources.

Local Level Action - General

Unlike state and federal level action, local efforts will have to be tailored to the individual needs of each jurisdiction, and the recommendations listed here apply only to the Eugene-Springfield area. The following general recommendations were approved by the Areawide Water Resources Advisory Committee and forwarded to the City Managers of Eugene and Springfield:

1. In order to be in compliance with and pursue implementation of adopted Metropolitan Planning Goals relating to Environmental Resources, River and Waterway Corridors and Environmental Design Elements, each city should prioritize urban runoff control activities and allocate funding to these activities based on these priorities.

2. In setting such priorities, the Cities of Eugene and Springfield should take particular note of the "special concern areas" as well as the pollution sources for each concern area as identified by the Areawide Water Resources Committee.

   These concern areas include Fern Ridge Reservoir (source - Amazon Creek), Bertelsen Slough (source - industrial areas in West Eugene), Alton Baker Park (source - "Q" Street Channel and Central-East Springfield), and Island Park (source - storm drainages in downtown Springfield).

3. Eugene and Springfield should establish a storm runoff and drainage service charge system and a portion of the funds generated from such user charges should be allocated to urban runoff pollution control. Such a service charge system should be fair and should be used, where appropriate, to reduce the tax burden on the General Fund.

4. Special efforts should be made to implement "runoff enhancement" programs, particularly regarding the establishment of spill prevention and cleanup plans, ongoing monitoring programs, public involvement efforts, and comprehensive channel and channel-vegetation management schedules.

5. Both Eugene and Springfield should maintain accurate maps and records on the sources of urban runoff pollution and chemical spills as well as on the location and beneficial uses associated with each drainage in their jurisdiction.

6. Eugene and Springfield should consider the results of the 208 Study and utilize the technical and financing reports, as appropriate, in implementing an urban runoff control and quality enhancement program.

In addition to the more general areawide policy recommendations, the following specific actions have been identified for each city, based on the results of technical and financial management reports. The actions may be appropriately pursued by City staffs.

Springfield

- Establish a public information program that will inform residents of the locations, uses and problems associated with the Springfield Millrace, Q Street Channel, and East 72nd Street Channel.
- Using public information, encourage recycling and reuse of hazardous and oily wastes and reduction of trash and litter deposition in storm channels.
- Establish a monitoring program focusing on spill and special impact detection for major storm drains to Island Park on the "Q" Street Channel and the South "Q" (or North 28th) ditch.
- Develop a plan for spill control and retention on major industrial area drainages, including particularly the South "Q" Channel, and the South A Street storm drain.
- Continue a street sanitation program with 3/week treatment in commercial and industrial areas when traffic density is greater than 10,000 vehicles per day.
- Develop a vegetation and channel management program for the "Q" Channel from 5th Street to Tekelma Street, utilizing appropriate non-chemical techniques where possible and including landscaping and shading where appropriate (Moffitt School and behind residences).
- Consider and design sediment control structures on the "Q" Channel below Tekelma Street and at the Marcola Shopping Plaza.
- Develop a resource management plan for the Springfield Millrace/Island Park system, including consideration of spill and oil control devices, periodic trash control and potential Willamette River diversion to the Island Park near shore.

- Coordinate park-related activities with Willamalane Park District.

Eugene

- Establish a public information program that will inform residents of the locations, problems and uses associated with the Eugene Millrace, Amazon Channel (including Willow Creek), A-2 and A-3 Channels, Willakenzie and Delta Floodways and Alton Baker Park Ponds.
- Using public information, encourage recycling and reuse of hazardous and oily wastes and reduction of trash and litter deposition in storm channels and storm drains. The major channels of concern are Amazon Channel and the Polk Street storm sewer system.
- Establish a monitoring program that will focus on spill and special impact detection for major storm drains to the Polk Street system to the A-2, A-3 and Amazon Channels and the Eugene Millrace.
- Develop a plan for spill control and retention for major industrial drainage areas, particularly including the A-3 Channel (including Roosevelt Ditch) and lower Amazon Channel, as well as portions of the A-1 Channel within Eugene's jurisdiction.
- Continue the current street sanitation program, with a focus on 3/week vacuum sweeping of all traffic areas with more than 12,000 vehicles/day and all industrial areas with more than 9,000 vehicles/day usage.
- Develop a vegetation and channel management program for the Amazon Channel, including elements relating to bank modification, clean-up and dredging maintenance scheduling, vegetation harvest and installation of trash and sediment control devices. Such a program should identify beneficial uses to be protected. At least six segments on the Amazon should be separately designated: Amazon above 29th, Amazon in Amazon Park, Amazon - concrete section, Amazon - Fairgrounds section to Chambers, Amazon - Chambers to Willow Creek, and Amazon Slough to Fern Ridge Reservoir.
- Develop a vegetation and channel management program for the A-3 Channel, including elements relating to oil spill control above Bertelsen Slough, vegetation (cattail) harvest, trash and sediment control, and identification of beneficial uses. At least three segments should be identified: A-3 above Bertelsen Slough, Bertelsen Slough, and A-3 from Bertelsen Slough to the old Amazon Channel.
- Develop a drainage management plan for Willow Creek -- this is important because of the identification of three rare or endangered streamside plant species in the lower Willow Creek Basin (this was not a direct part of the NURP Project but is a subdrainage of Amazon Channel).
- Develop a drainage management plan for the Delta Ponds, with attention to future park plans, identification of uses, and determination of nutrient sources.

- Develop a cooperative plan with Springfield and Eugene for the protection of water quality in the Alton Baker Ponds. Such a cooperative plan would identify appropriate City of Springfield, Lane County and City of Eugene actions and would focus particularly on spill and sediment control, removal of sewer overflows, vegetation management and removal, and channel maintenance dredging.

- Consider the design and installation of sediment control structures on the Amazon Channel in Eugene. Three sites are identified in the financial management studies.

- Continue to investigate the costs and benefits of the development of a canal (Emerald Canal) connection between the Willamette River and the Amazon Channel.

REFERENCES

Brown and Caldwell. 1979. Storm Drainage Study for East Springfield. City of Springfield. 62 p and maps.

Eugene and Springfield. 1980. Metro Area General Plan. L-COG.

Eugene, Springfield, and Lane County. 1982. 1982 Amendments to the August 1980 Metropolitan Area General Plan. L-COG. 39 p.

Jordan/Avent and Associates. 1977. Urban Stormwater Analysis Eugene-Springfield Area. L-COG. 131 p.

Kramer, Chin and Mayo and D. Dornbusch and Co., Inc. 1981. Metropolitan Area Summary - Urban Stormwater Runoff Financial Management Program for the Eugene-Springfield Metropolitan Area. L-COG. 70 p.

____________. 1981. Urban Stormwater Runoff Financial Management Program for the City of Eugene. L-COG. 93 p.

____________. 1981. Urban Stormwater Runoff Financial Management Program for the City of Springfield. L-COG. 90 p.

Kreag, R. A. and G. Rosenthal. 1982. Control of Urban Runoff Pollutants Through Vegetation Management - A Pilot Study on Amazon Channel Eugene, Oregon. L-COG. 43 p.

Lane Council of Governments. 1977.. 208 Wastewater Management Program Summary Report. 31 p and Appendices.

____________. 1978. Revised Urban Storm Runoff Management Study Summary Report. 39 p.

____________. 1978. Revised Upper Willamette River Basin Industrial Wastes Study. 89 p and Appendices.

Rosenthal, G. 1982. Street Sweeping Pilot Study Springfield-Eugene, Oregon. L-COG. 35 p.

Rosenthal, G. and R. A. Kreag. 1982. Sediment Trap Pilot Study on the Amazon Channel, Eugene, Oregon Subreport. L-COG. 18 p.

Saunders, G. P. 1982. Biological Reconnaissance of an Urban Drainage System, Amazon Channel Eugene, Oregon. L-COG. 32 p.

Versar, Inc. 1980. Monitoring of Toxic Pollutants in Urban Runoff: A Guidance Manual. U.S. EPA. 83 p and Appendices

____________. 1982. Report of Analytical Data (Five Samples) for the Lane, Oregon NURP Study Area. U.S. EPA.

APPENDICES

APPENDIX A

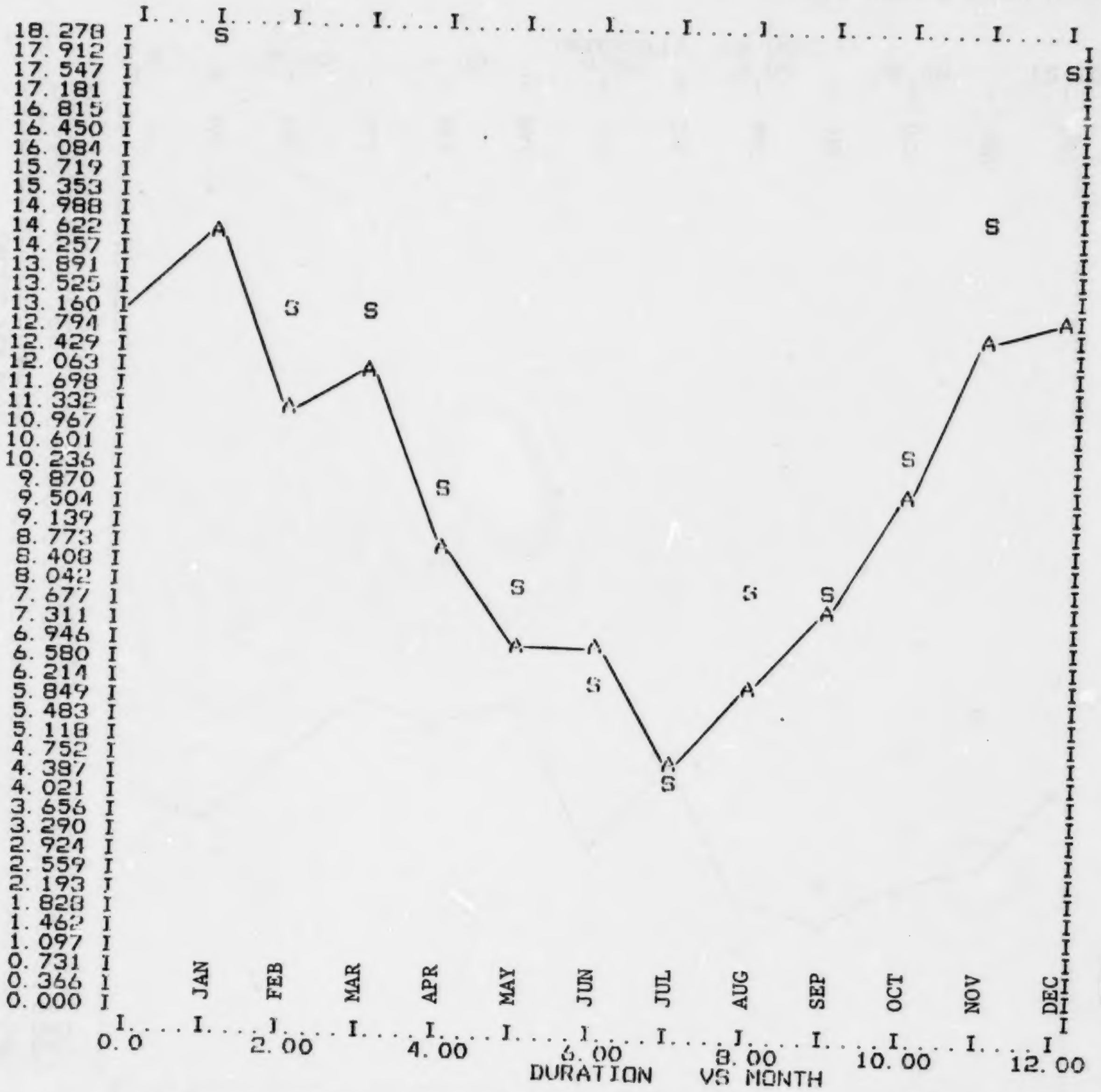
RAINFALL DATA

CONTENTS

SYNOP Monthly, Yearly and Period of Record Statistical Plots Using 6-Hour "Interevent" Time for Storm Intensity, Duration, Volume and Time Between Storms (Delta).

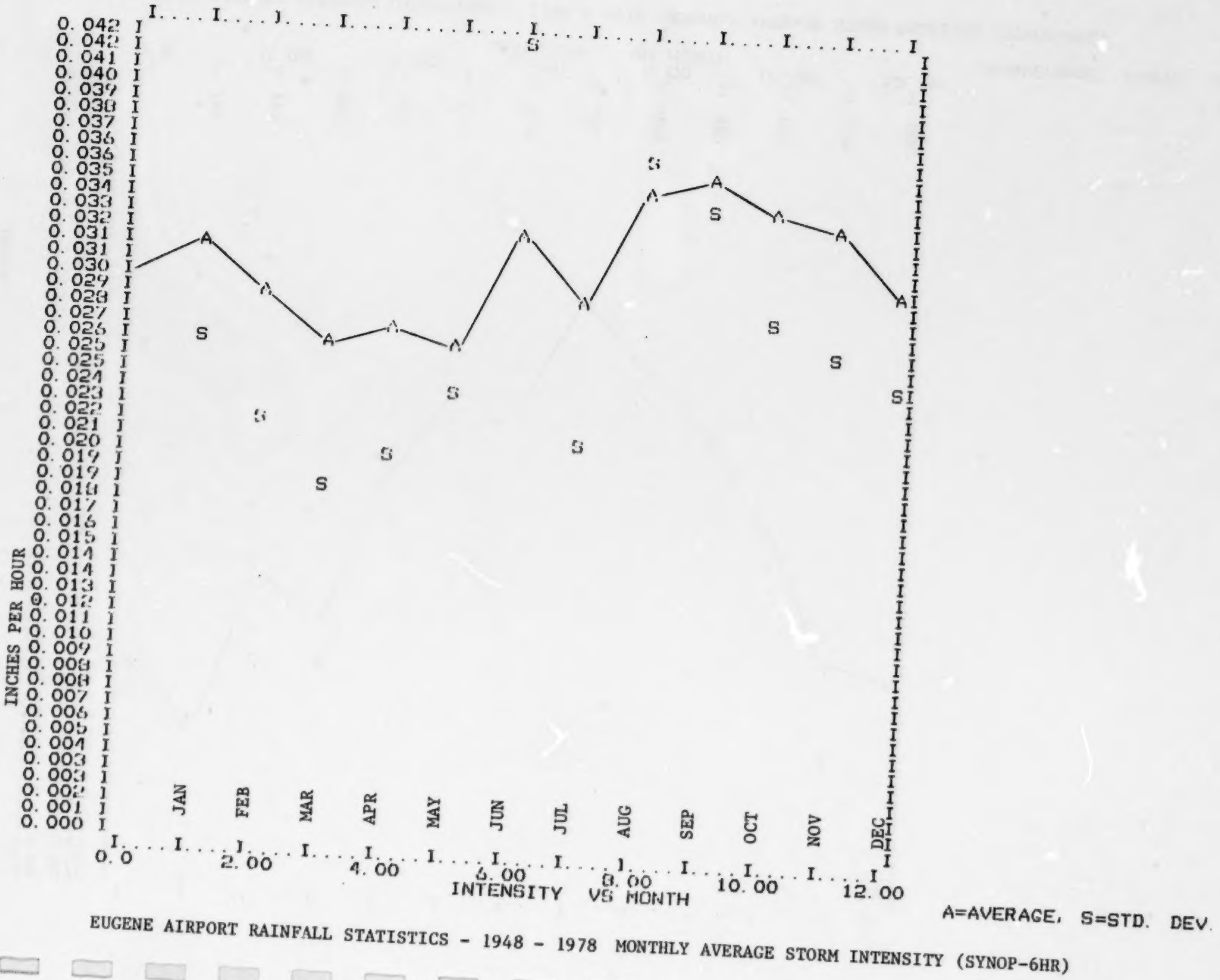
Daily Rainfall at Eugene Fire Station - 33rd Avenue, Donald Street and Airport (Weather Bureau data)

Statistical Comparison of Storm Rainfall at Four Stations

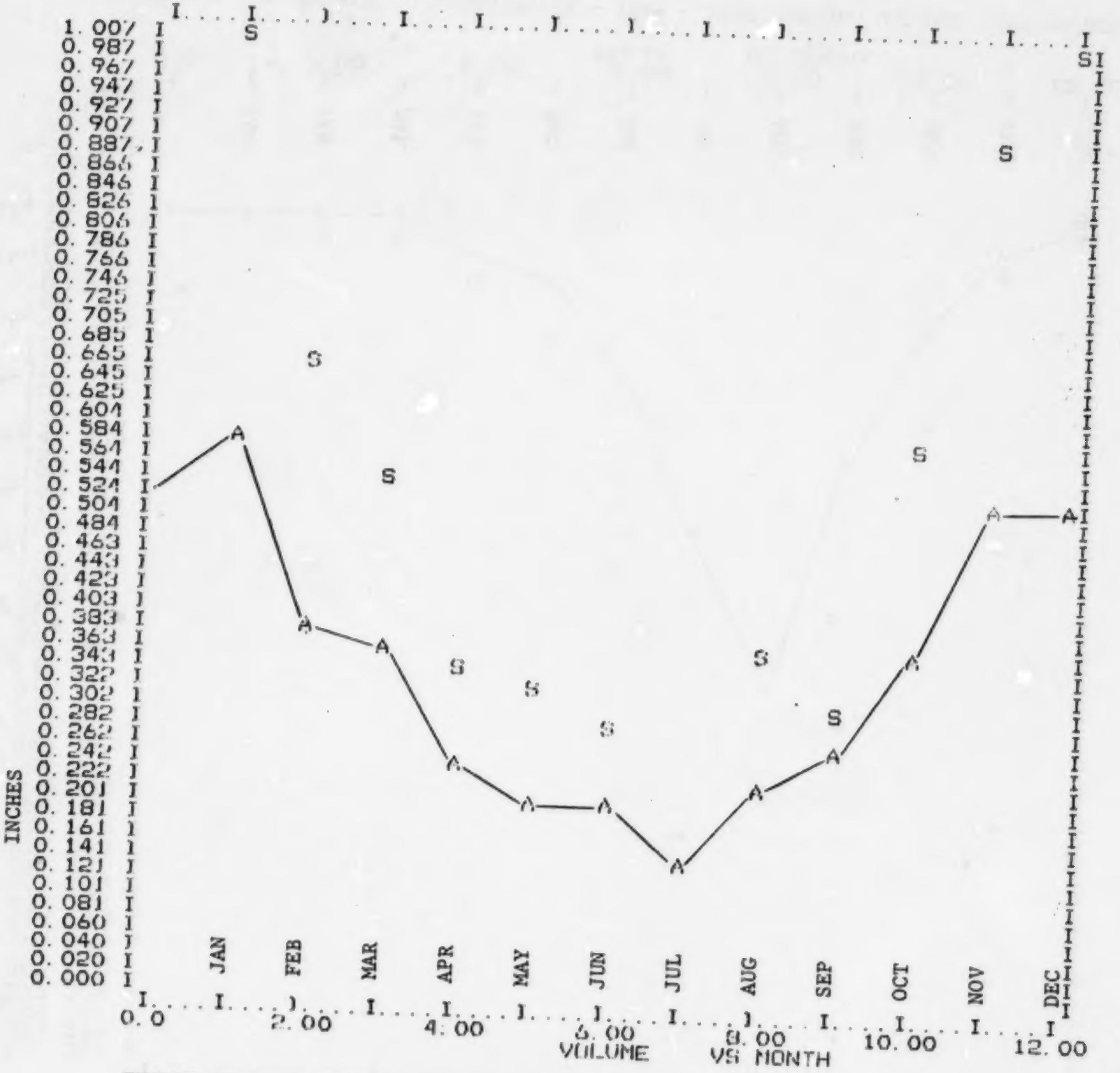


EUGENE AIRPORT RAINFALL STATISTICS - 1948 - 1978 MONTHLY AVERAGE STORM DURATION (SYNOP-6HR)

Reproduced from best available copy.

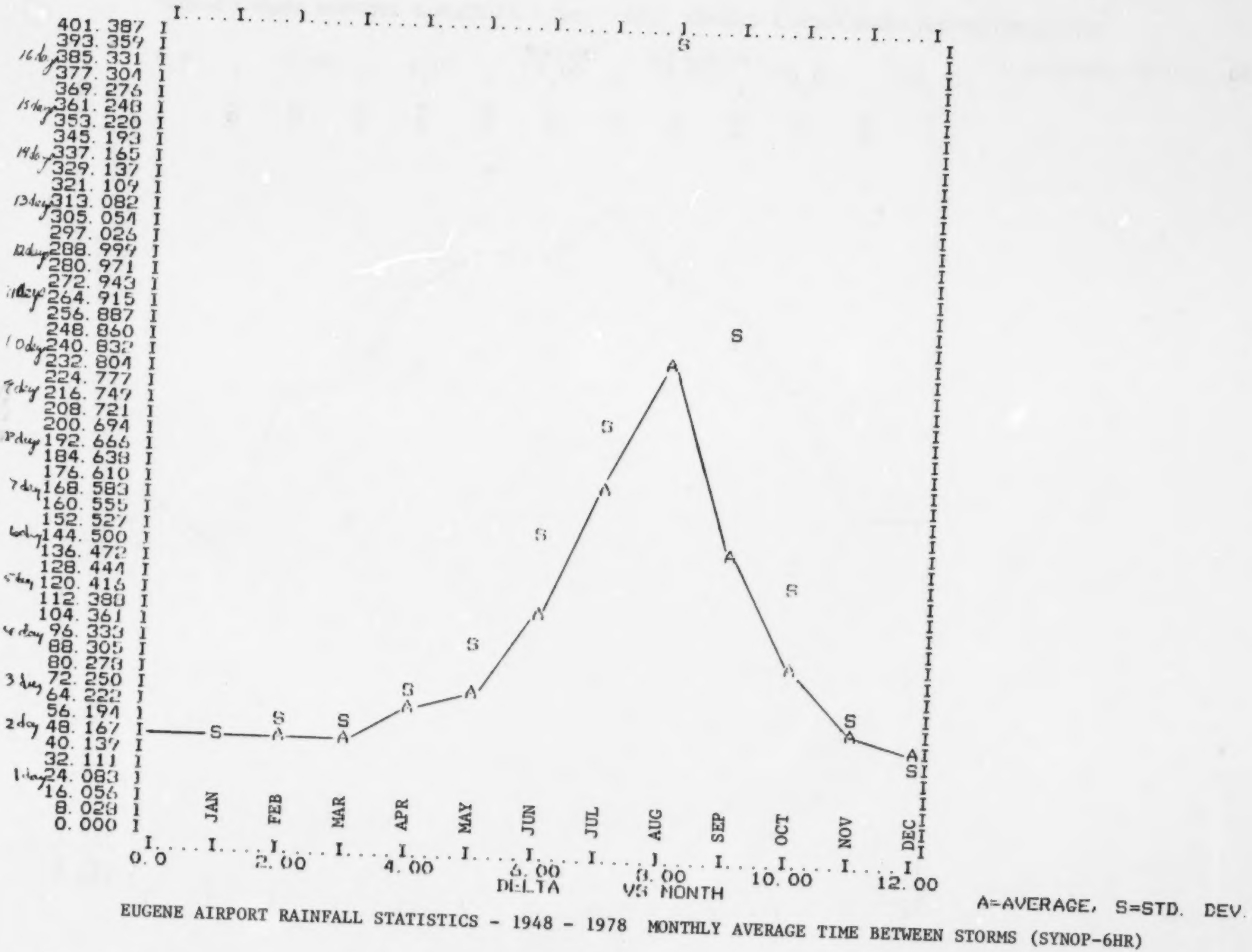


EUGENE AIRPORT RAINFALL STATISTICS - 1948 - 1978 MONTHLY AVERAGE STORM INTENSITY (SYNOP-6HR)

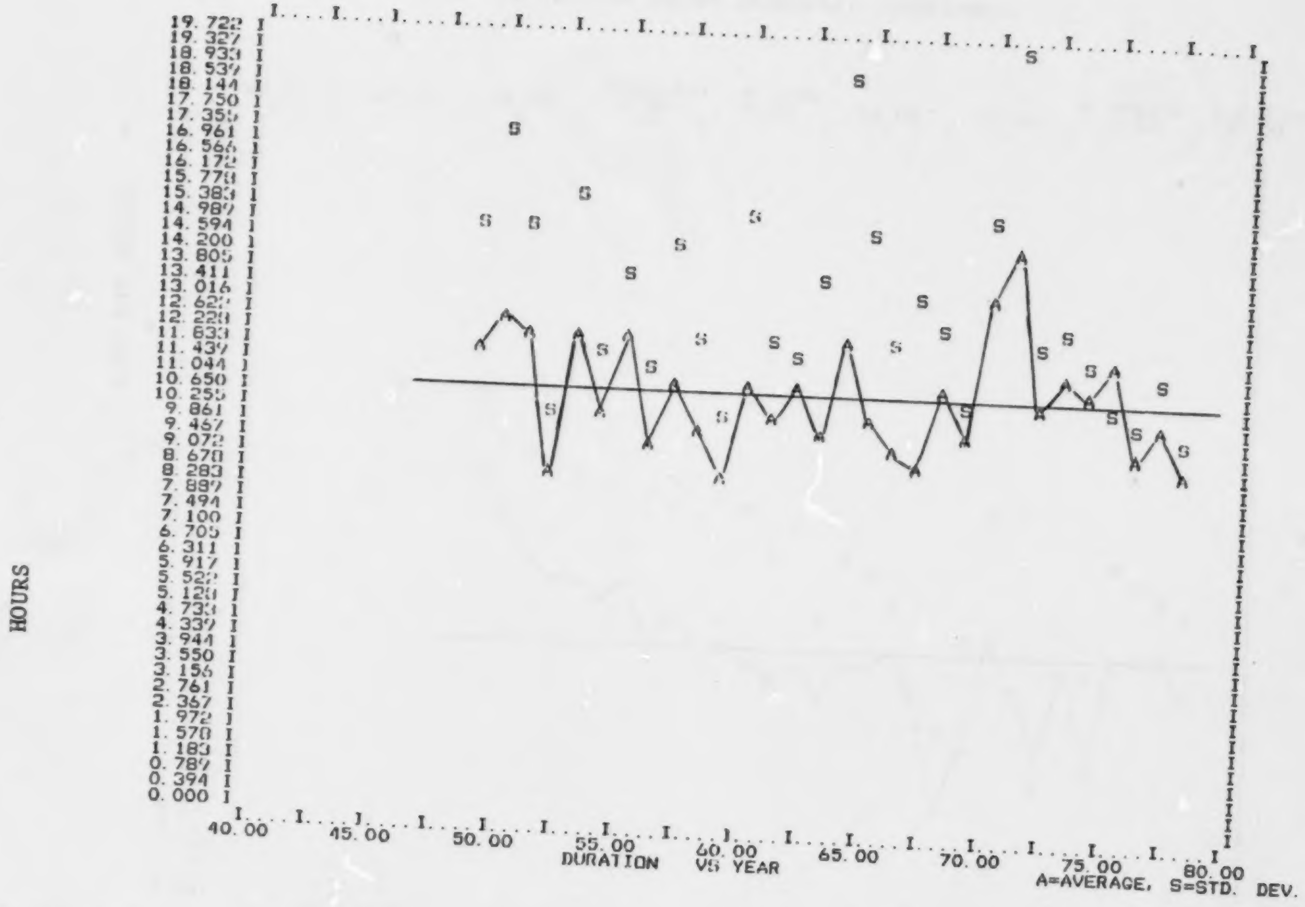


EUGENE AIRPORT RAINFALL STATISTICS - 1948 - 1978 MONTHLY AVERAGE STORM VOLUME (SYNOP-6HR)

2

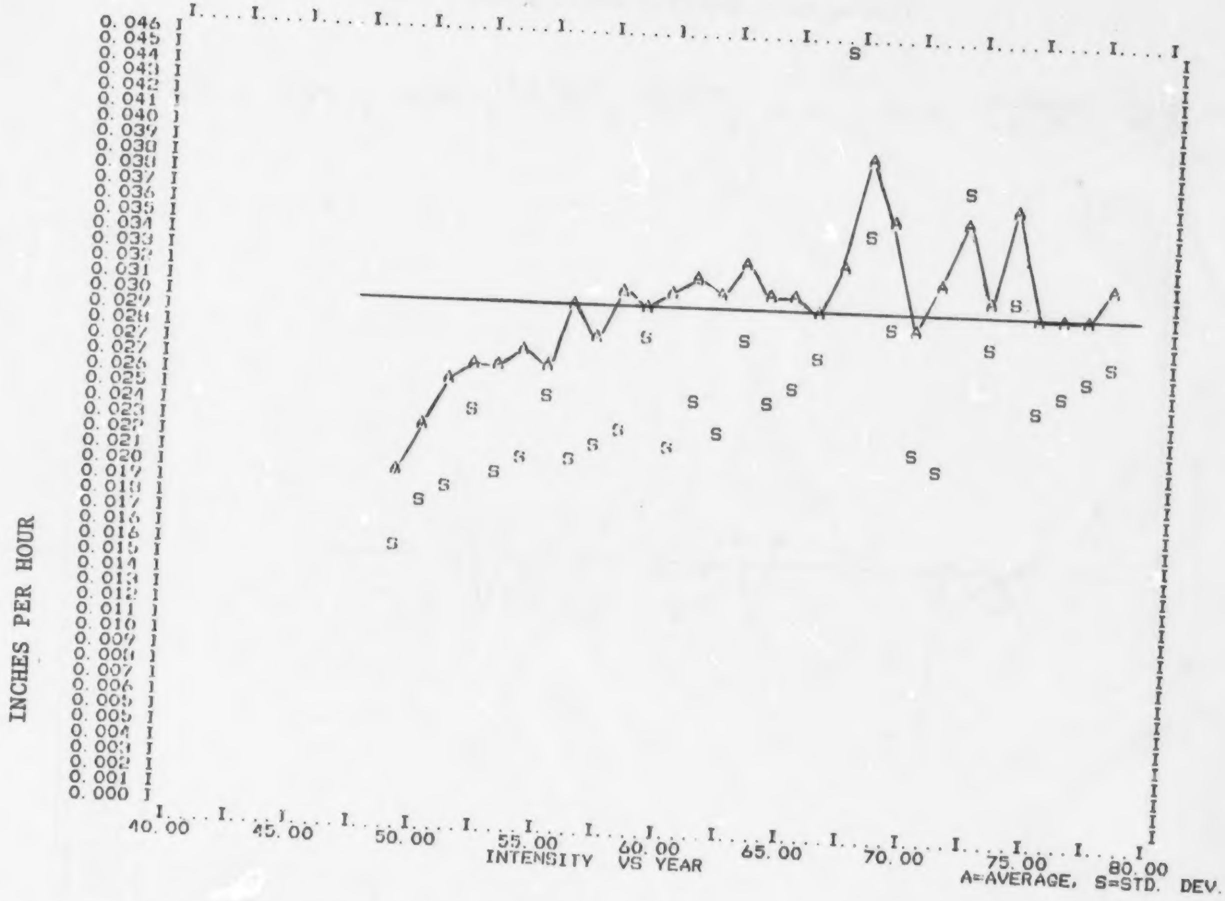


EUGENE AIRPORT RAINFALL STATISTICS - 1948 - 1978 MONTHLY AVERAGE TIME BETWEEN STORMS (SYNOP-6HR)

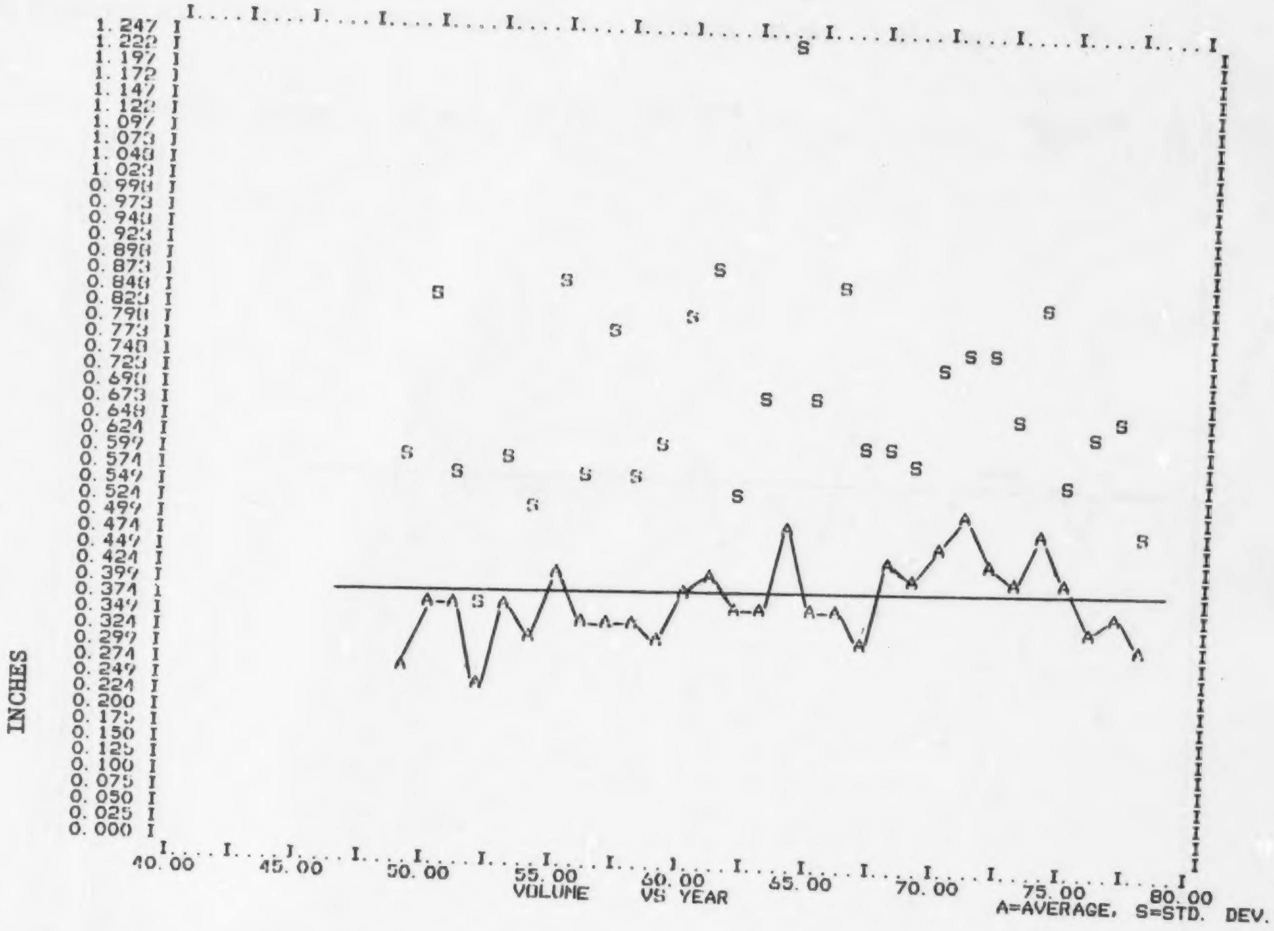


EUGENE AIRPORT RAINFALL STATISTICS - YEARLY AVERAGE STORM DURATION (SYNOP-6HR)

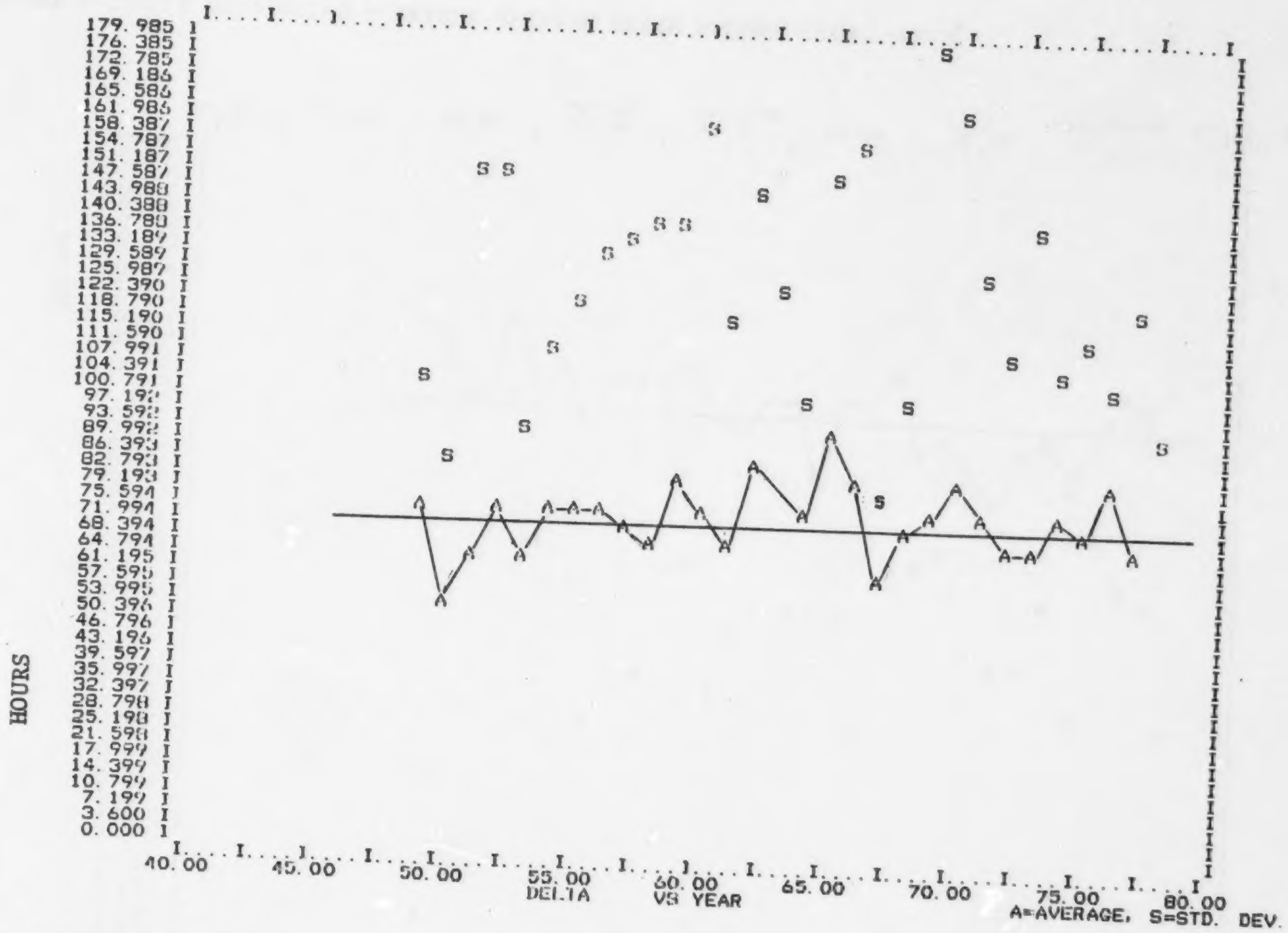
3



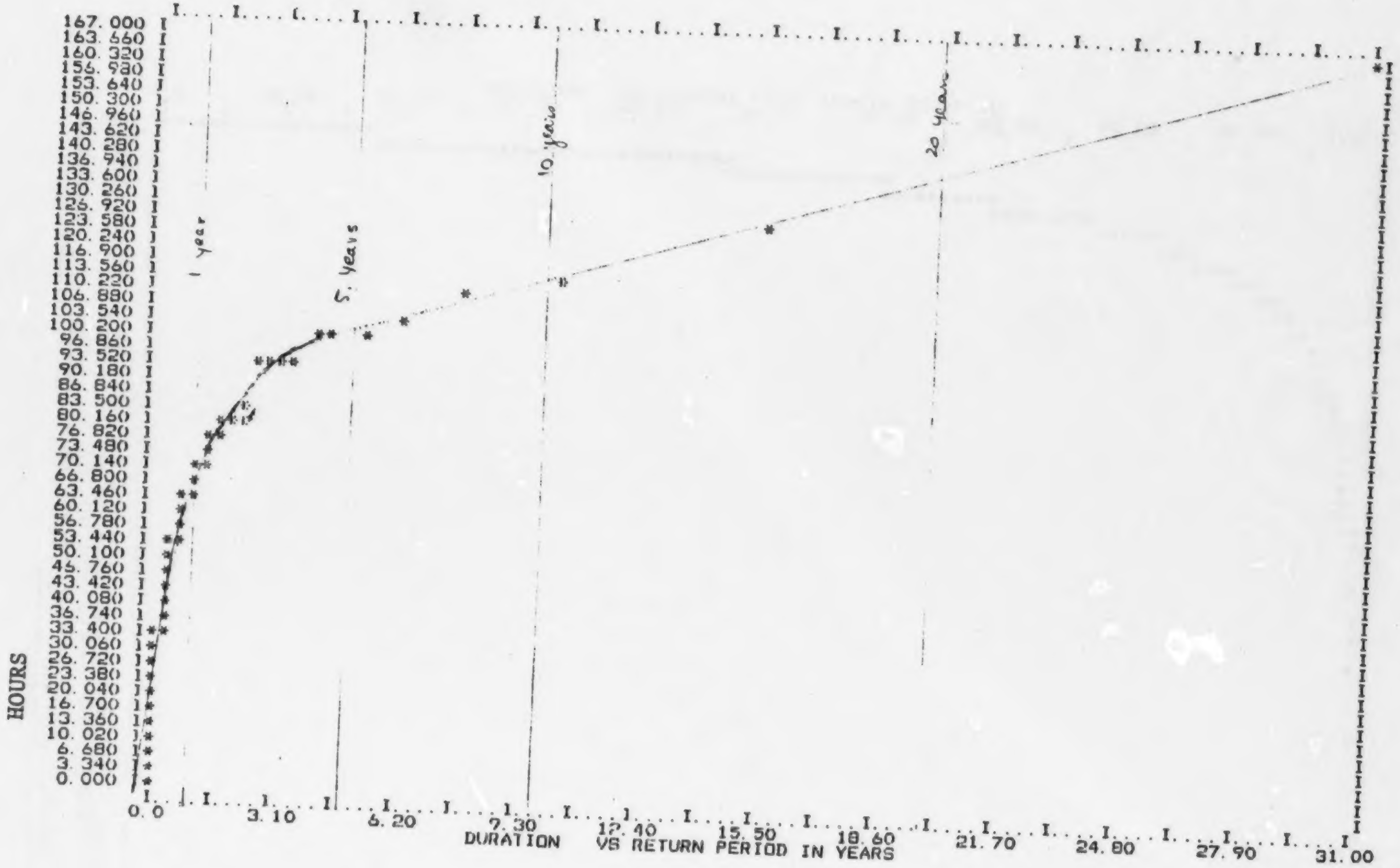
EUGENE AIRPORT RAINFALL STATISTICS - YEARLY AVERAGE STORM INTENSITY (SYNOP-6HR)



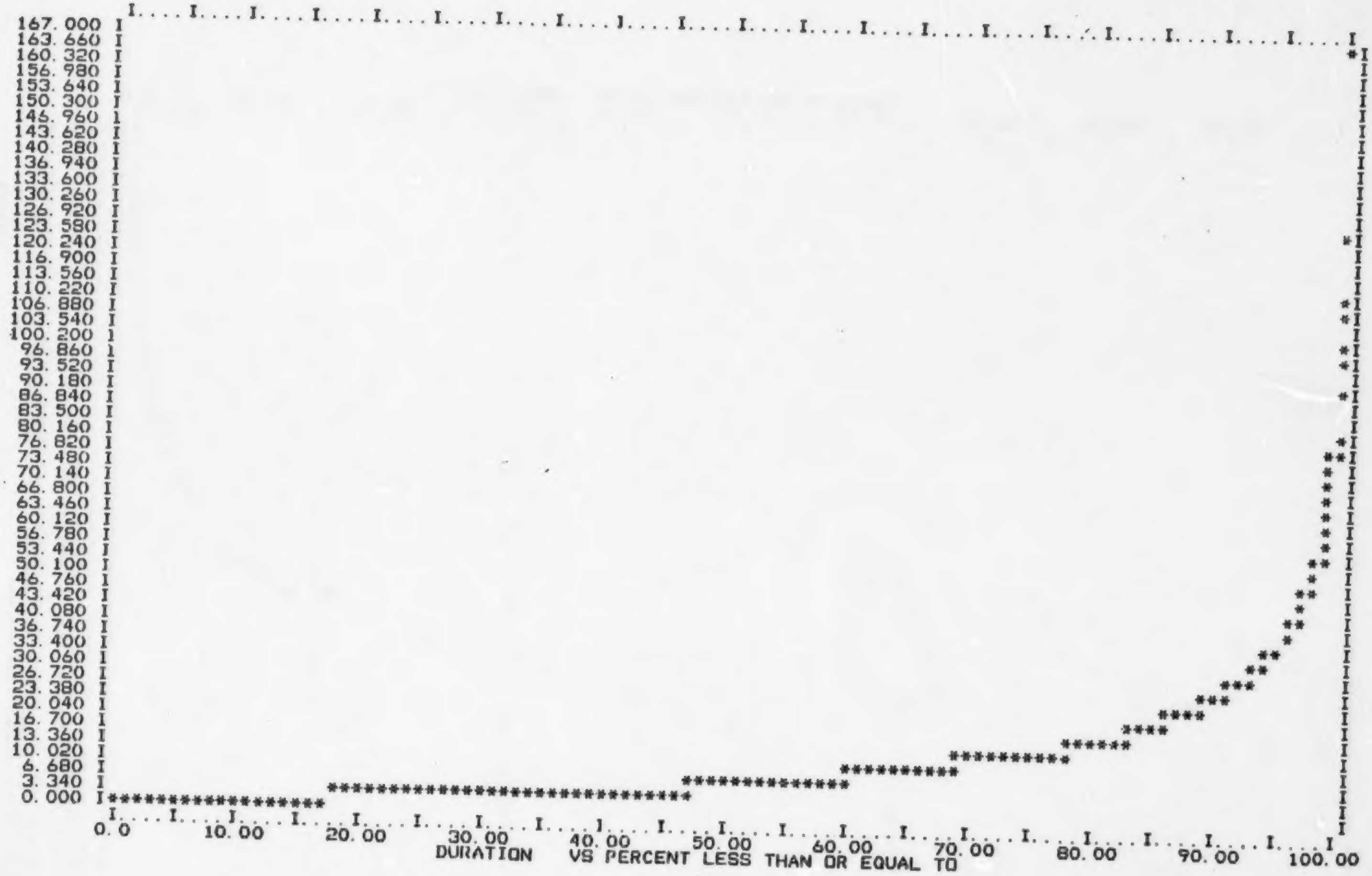
EUGENE AIRPORT RAINFALL STATISTICS - YEARLY AVERAGE STORM VOLUME (SYNOP-6HR)



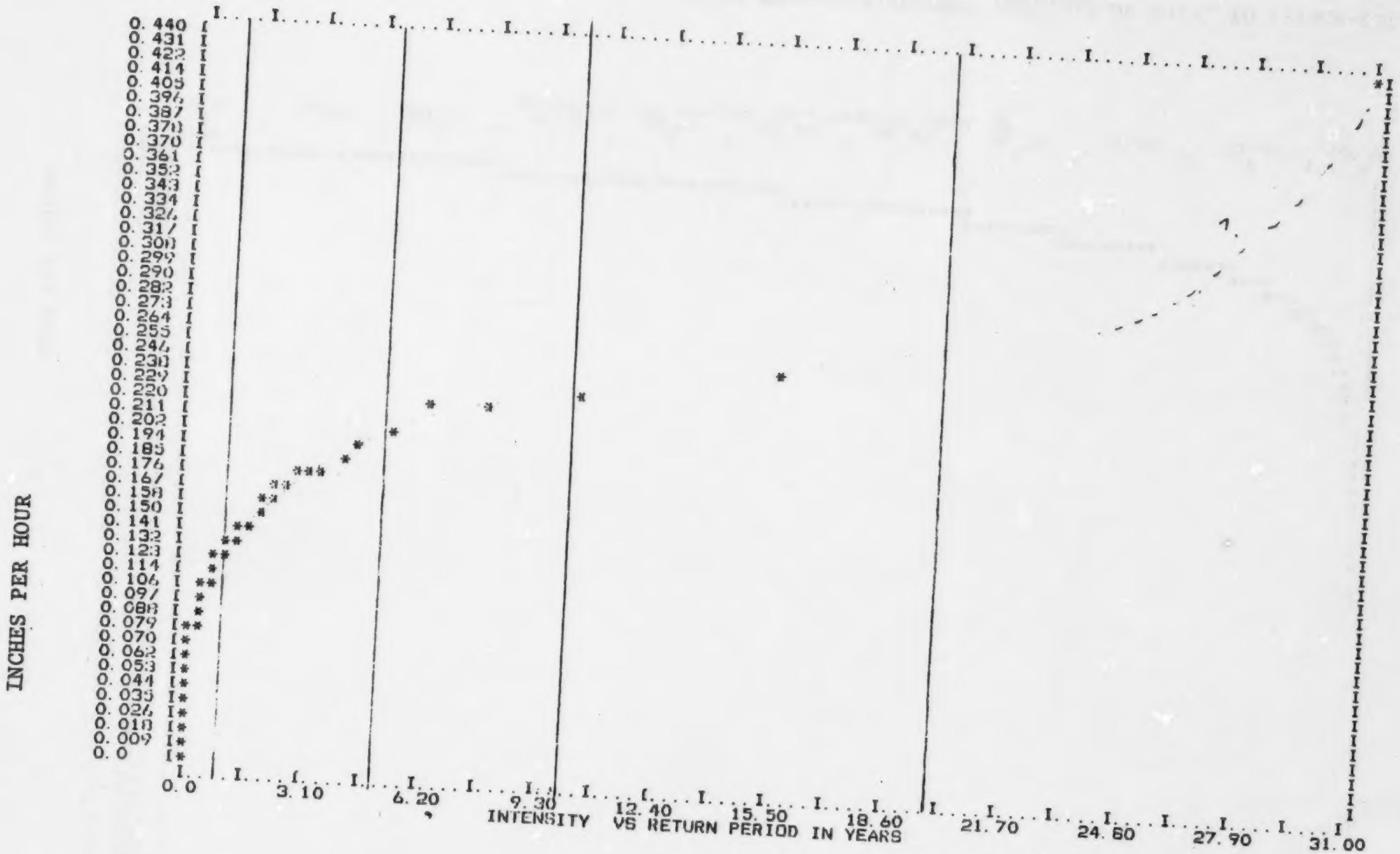
EUGENE AIRPORT RAINFALL STATISTICS - YEARLY AVERAGE TIME BETWEEN STORMS (SYNOP-6HR)



EUGENE AIRPORT RAINFALL STATISTICS - STORM DURATION RETURN PERIOD (SYNOP-6HR)

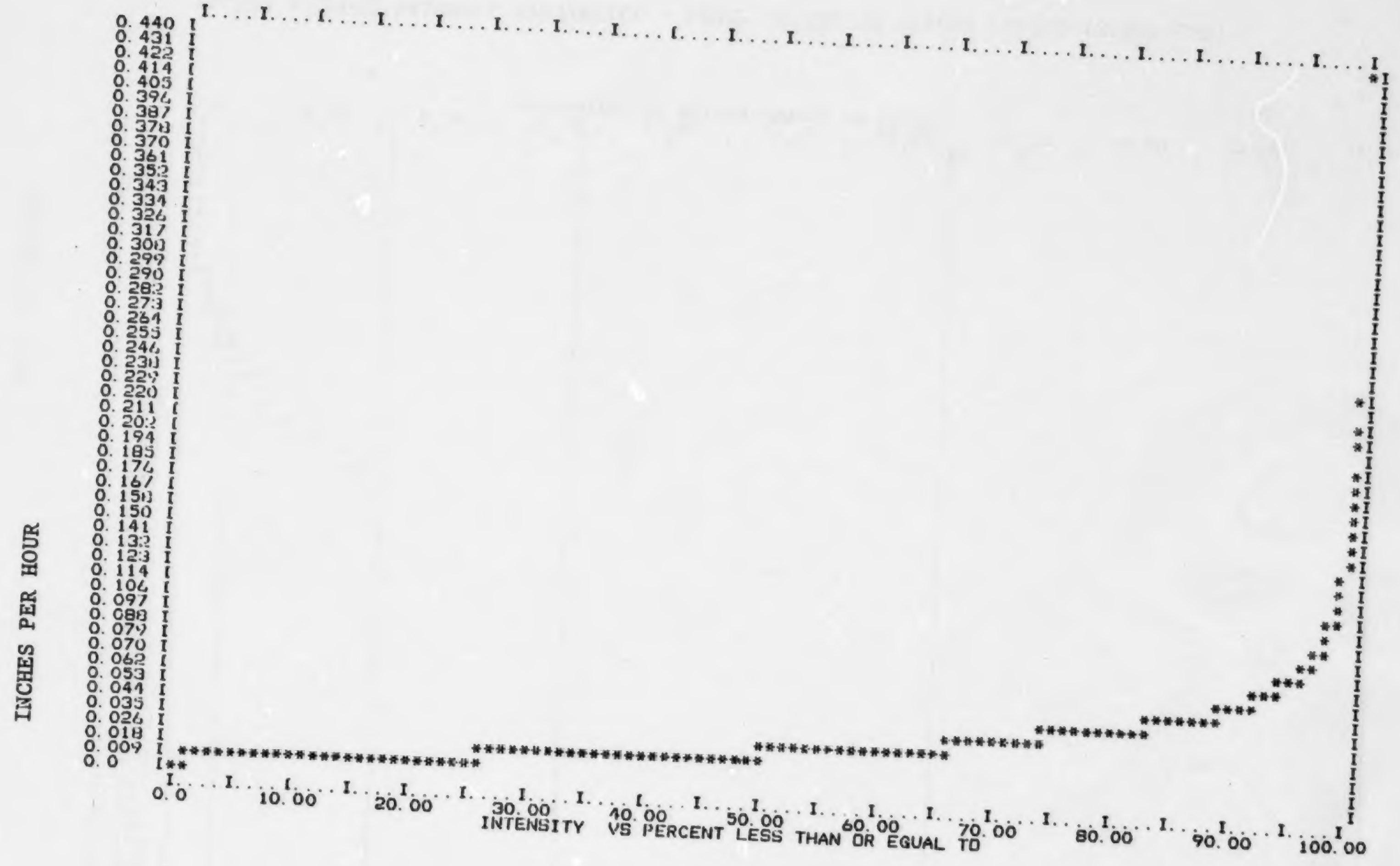


EUGENE AIRPORT RAINFALL STATISTICS - STORM DURATION PERCENT LESS THAN OR EQUAL TO (SYNOP-6HR)

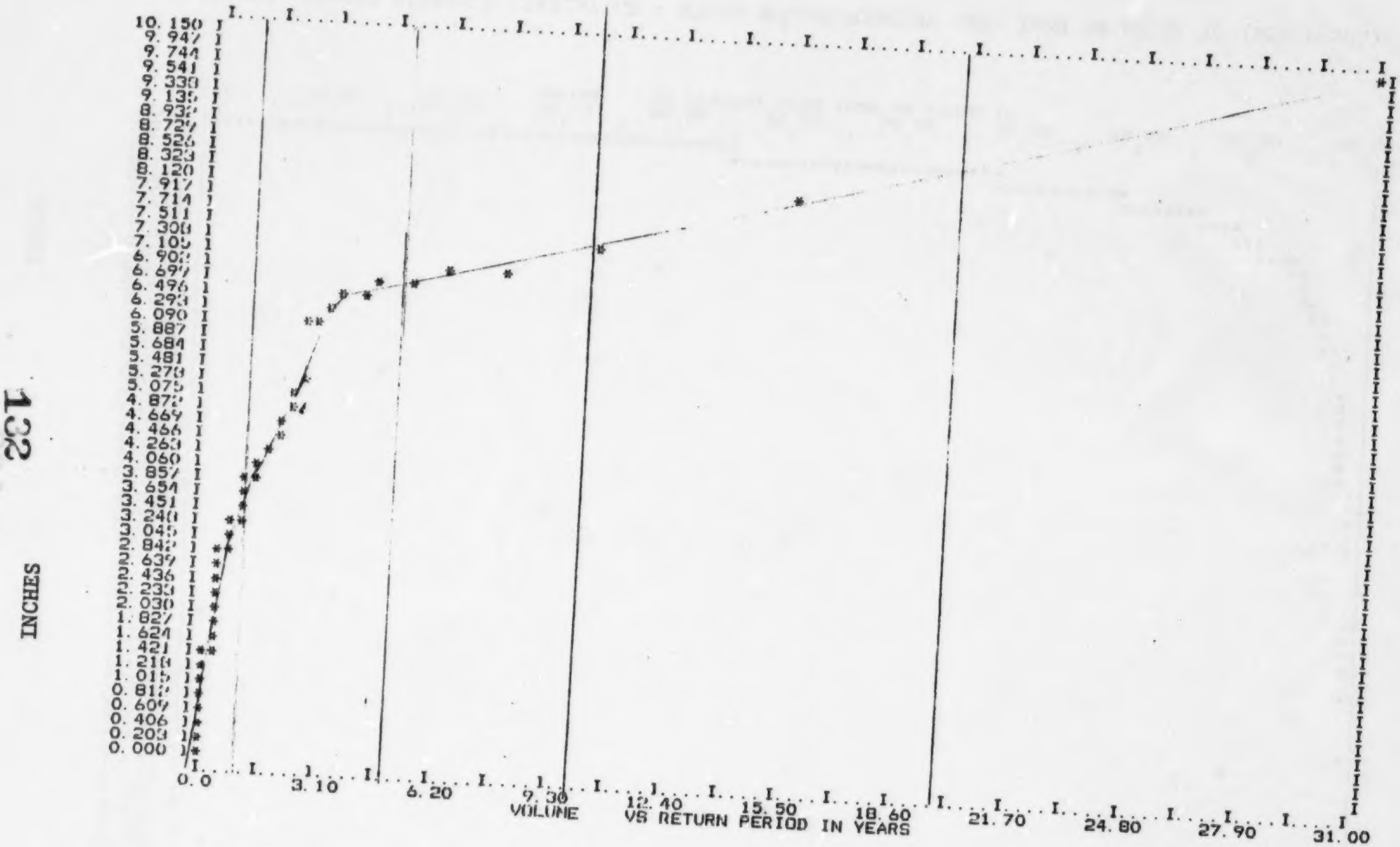


EUGENE AIRPORT RAINFALL STATISTICS - STORM INTENSITY RETURN PERIOD (SYNOP-6HR)

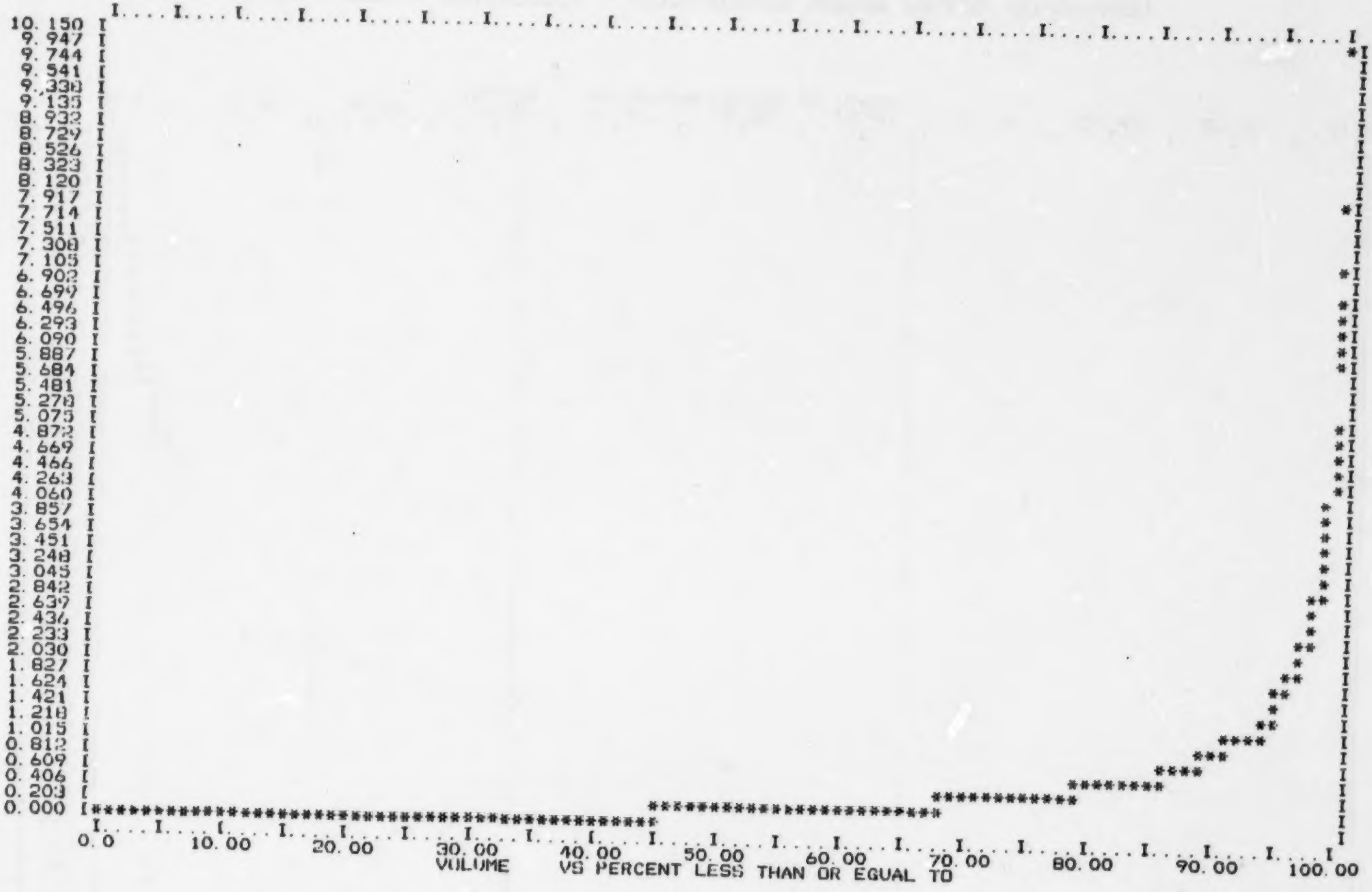
6



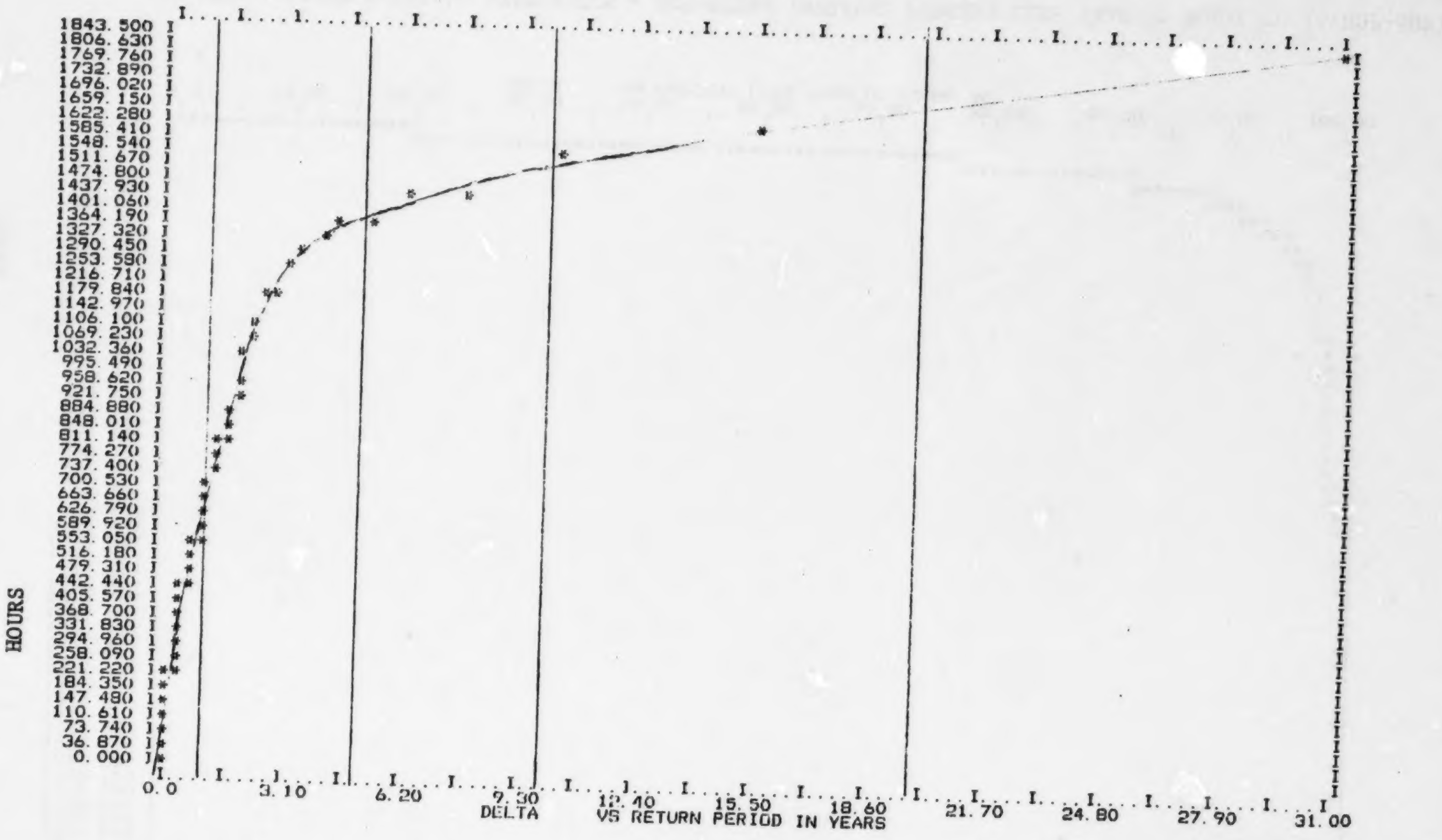
EUGENE AIRPORT RAINFALL STATISTICS - STORM INTENSITY PERCENT LESSTHAN OR EQUAL TO (SYNOP-6HR)



EUGENE AIRPORT RAINFALL STATISTICS - STORM VOLUME RETURN PERIOD (SYNOP-6HR)

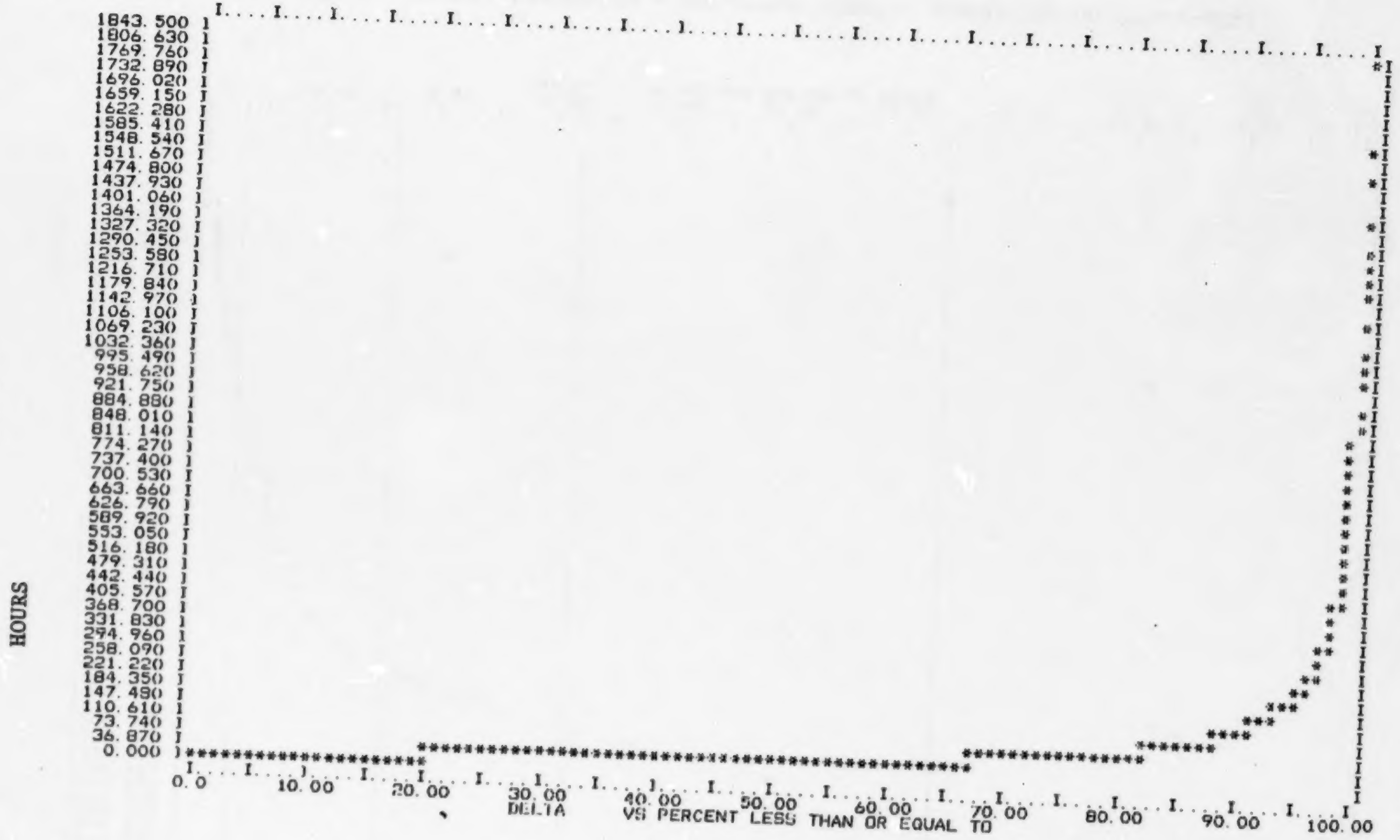


EUGENE AIRPORT RAINFALL STATISTICS - STORM VOLUME PERCENT LESS THAN OR EQUAL TO (SYNOP-6HR)



EUGENE AIRPORT RAINFALL STATISTICS - NON-STORM INTERVAL RETURN PERIOD (SYNOP-6HR)

8



EUGENE AIRPORT RAINFALL STATISTICS - NON-STORM INTERVAL PERCENT LESS THAN OR EQUAL TO (SYNOP-6HR)

Daily rainfall at Eugene Fire Station (FS) and Airport (AP):inches x 100

DATE	FS	AP
01 14 80	075	097
01 15 80	000	000
01 16 80	027	034
01 17 80	000	003
01 18 80	000	000
01 19 80	000	000
01 20 80	000	000
01 21 80	000	000
01 22 80	000	000
01 23 80	000	000
01 24 80	000	000
01 25 80	000	000
01 26 80	000	000
01 27 80	000	000
01 28 80	000	000
01 29 80	000	000
01 30 80	000	000
01 31 80	000	000
02 01 80	025	079
02 02 80	005	014
02 03 80	000	000
02 04 80	002	000
02 05 80	006	030
02 06 80	011	037
02 07 80	000	000
02 08 80	000	000
02 09 80	000	000
02 10 80	000	000
02 11 80	000	000
02 12 80	000	000
02 13 80	000	000
02 14 80	000	000
02 15 80	000	000
02 16 80	004	000
02 17 80	026	034
02 18 80	050	065
02 19 80	005	017
02 20 80	004	008
02 21 80	000	000
02 22 80	030	071
02 23 80	000	000
02 24 80	000	002
02 25 80	025	062
02 26 80	000	005
02 27 80	027	033
02 28 80	000	011
02 29 80	000	000
03 01 80	000	000
03 02 80	000	000
03 03 80	015	002
03 04 80	023	023
03 05 80	003	006
03 06 80	008	001
03 07 80	000	000
03 08 80	000	004
03 09 80	000	000
03 10 80	040	047
03 11 80	024	020
03 12 80	040	059
03 13 80	124	167
03 14 80	058	067
03 15 80	030	027
03 16 80	000	000
03 17 80	015	011
03 18 80	000	000
03 19 80	000	000
03 20 80	023	024
03 21 80	000	001
03 22 80	000	000
03 23 80	000	000
03 24 80	000	000
03 25 80	000	000
03 26 80	016	020
03 27 80	000	000
03 28 80	000	000
03 29 80	000	000
03 30 80	000	000
03 31 80	010	032
04 01 80	000	000
04 02 80	000	000
04 03 80	010	023
04 04 80	012	013
04 05 80	024	037
04 06 80	074	112
04 07 80	002	001
04 08 80	014	020
04 09 80	046	032
04 10 80	000	001
04 11 80	000	000
04 12 80	000	000
04 13 80	000	000
04 14 80	017	030
04 15 80	000	000
04 16 80	000	000
04 17 80	000	000
04 18 80	000	000
04 19 80	010	025
04 20 80	068	096
04 21 80	012	021
04 22 80	000	000
04 23 80	000	000
04 24 80	006	009
04 25 80	000	000
04 26 80	000	000
04 27 80	000	000
04 28 80	000	000
04 29 80	000	000
04 30 80	000	000
05 01 80	000	000
05 02 80	000	000
05 03 80	000	000
05 04 80	000	000
05 05 80	000	000
05 06 80	000	000
05 07 80	000	000
05 08 80	008	003
05 09 80	020	041
05 10 80	010	016
05 11 80	000	000
05 12 80	000	000
05 13 80	003	000
05 14 80	000	003
05 15 80	000	000
05 16 80	000	000
05 17 80	000	000
05 18 80	000	000
05 19 80	000	000
05 20 80	000	000
05 21 80	001	008
05 22 80	006	016
05 23 80	022	027
05 24 80	020	016
05 25 80	000	001
05 26 80	020	008
05 27 80	000	000
05 28 80	000	000
05 29 80	000	000
05 30 80	000	000
05 31 80	000	000
06 01 80	009	006
06 02 80	014	010
06 03 80	005	002
06 04 80	000	000
06 05 80	000	000
06 06 80	003	016
06 07 80	020	020
06 08 80	009	002
06 09 80	000	000
06 10 80	000	000
06 11 80	000	000
06 12 80	000	000
06 13 80	043	078
06 14 80	000	000
06 15 80	000	000
06 16 80	000	000
06 17 80	000	000
06 18 80	000	000
06 19 80	000	000
06 20 80	000	002
06 21 80	000	000
06 22 80	007	009
06 23 80	006	003
06 24 80	011	044
06 25 80	018	015
06 26 80	000	000
06 27 80	000	000
06 28 80	000	000
06 29 80	000	000
06 30 80	000	000
07 01 80	000	000
07 02 80	000	000
07 03 80	025	026
07 04 80	000	004
07 05 80	000	000
07 06 80	000	000
07 07 80	000	000
07 08 80	000	000
07 09 80	094	009
07 10 80	000	000
07 11 80	000	000

Daily rainfall at Eugene Fire Station (FS) and Airport (AP): inches x 100

DATE	FS	AP
07 12 80	000	000
07 13 80	000	000
07 14 80	000	000
07 15 80	000	000
07 16 80	000	000
07 17 80	000	000
07 18 80	000	000
07 19 80	000	000
07 20 80	000	000
07 21 80	000	000
07 22 80	000	000
07 23 80	000	000
07 24 80	000	000
07 25 80	000	000
07 26 80	000	000
07 27 80	000	000
07 28 80	000	000
07 29 80	000	000
07 30 80	000	000
07 31 80	000	000
08 01 80	000	000
08 02 80	000	000
08 03 80	000	000
08 04 80	000	000
08 05 80	000	000
08 06 80	000	000
08 07 80	000	000
08 08 80	000	000
08 09 80	000	000
08 10 80	000	000
08 11 80	000	000
08 12 80	000	000
08 13 80	000	000
08 14 80	000	000
08 15 80	000	000
08 16 80	000	000
08 17 80	000	000
08 18 80	000	000
08 19 80	000	000
08 20 80	000	000
08 21 80	000	000
08 22 80	000	000
08 23 80	000	000
08 24 80	000	000
08 25 80	000	000
08 26 80	000	000
08 27 80	000	000
08 28 80	000	000
08 29 80	000	000
08 30 80	000	002
08 31 80	000	000
09 01 80	000	000
09 02 80	015	020
09 03 80	000	000
09 04 80	000	000
09 05 80	000	000
09 06 80	000	000
09 07 80	000	003
09 08 80	000	000
09 09 80	000	000
09 10 80	000	000
09 11 80	000	000
09 12 80	018	018
09 13 80	000	000
09 14 80	000	000
09 15 80	000	000
09 16 80	000	000
09 17 80	000	000
09 18 80	009	007
09 19 80	000	012
09 20 80	019	014
09 21 80	000	000
09 22 80	000	000
09 23 80	000	000
09 24 80	000	000
09 25 80	000	000
09 26 80	000	000
09 27 80	000	000
09 28 80	000	001
09 29 80	000	000
09 30 80	000	000
10 01 80	000	000
10 02 80	000	000
10 03 80	000	000
10 04 80	000	000
10 05 80	000	000
10 06 80	000	000
10 07 80	000	000
10 08 80	000	000
10 09 80	000	000
10 10 80	000	000
10 11 80	013	012
10 12 80	040	042
10 13 80	027	038
10 14 80	000	000
10 15 80	000	000
10 16 80	000	000
10 17 80	000	000
10 18 80	000	000
10 19 80	000	000
10 20 80	000	000
10 21 80	000	000
10 22 80	000	000
10 23 80	000	000
10 24 80	018	016
10 25 80	024	014
10 26 80	041	068
10 27 80	000	000
10 28 80	000	000
10 29 80	000	000
10 30 80	000	000
10 31 80	000	000
11 01 80	040	074
11 02 80	000	001
11 03 80	002	002
11 04 80	000	000
11 05 80	037	072
11 06 80	058	071
11 07 80	123	156
11 08 80	052	040
11 09 80	025	030
11 10 80	000	000
11 11 80	000	000
11 12 80	000	000
11 13 80	000	000
11 14 80	031	043
11 15 80	000	000
11 16 80	000	000
11 17 80	000	000
11 18 80	000	000
11 19 80	000	000
11 20 80	000	000
11 21 80	103	200
11 22 80	026	015
11 23 80	030	025
11 24 80	000	000
11 25 80	008	020
11 26 80	000	000
11 27 80	017	026
11 28 80	000	000
11 29 80	064	091
11 30 80	002	000
12 01 80	067	084
12 02 80	236	448
12 03 80	317	281
12 04 80	044	033
12 05 80	034	045
12 06 80	009	002
12 07 80	000	000
12 08 80	000	000
12 09 80	000	000
12 10 80	000	000
12 11 80	000	000
12 12 80	000	000
12 13 80	000	000
12 14 80	000	000
12 15 80	000	000
12 16 80	000	000
12 17 80	000	000
12 18 80	000	000
12 19 80	010	021
12 20 80	003	004
12 21 80	060	087
12 22 80	030	036
12 23 80	000	000
12 24 80	129	242
12 25 80	048	152
12 26 80	000	002
12 27 80	030	030
12 28 80	000	000
12 29 80	000	006
12 30 80	000	000
12 31 80	000	000
01 01 81	000	000
01 02 81	000	000
01 03 81	000	001
01 04 81	000	000
01 05 81	000	000
01 06 81	000	000
01 07 81	000	000

Daily rainfall at Eugene Fire Station (FS) and Airport (AP): inches x 100

DATE	FS	AP
01 08 81	000	000
01 09 81	000	000
01 10 81	000	000
01 11 81	000	000
01 12 81	000	000
01 13 81	000	000
01 14 81	000	000
01 15 81	000	000
01 16 81	000	000
01 17 81	005	005
01 18 81	000	000
01 19 81	000	000
01 20 81	000	005
01 21 81	016	023
01 22 81	040	044
01 23 81	011	020
01 24 81	004	003
01 25 81	000	018
01 26 81	025	019
01 27 81	047	049
01 28 81	038	032
01 29 81	000	002
01 30 81	000	002
01 21 81	000	000
02 01 81	000	000
02 02 81	000	000
02 03 81	000	000
02 04 81	010	006
02 05 81	011	004
02 06 81	000	000
02 07 81	000	000
02 08 81	000	000
02 09 81	000	000
02 10 81	005	006
02 11 81	005	002
02 12 81	000	000
02 13 81	068	090
02 14 81	008	006
02 15 81	020	029
02 16 81	039	072
02 17 81	021	026
02 18 81	050	076
02 19 81	051	051
02 20 81	000	000
02 21 81	000	000
02 22 81	000	000
02 23 81	027	015
02 24 81	024	026
02 25 81	000	000
02 26 81	031	026
02 27 81	000	000
02 28 81	000	000
03 01 81	000	000
03 02 81	000	000
03 03 81	065	080
03 04 81	009	030
03 05 81	000	000
03 06 81	000	000
03 07 81	006	004
03 08 81	000	000
03 09 81	000	000
03 10 81	004	000
03 11 81	000	000
03 12 81	000	000
03 13 81	000	000
03 14 81	000	000
03 15 81	055	051
03 16 81	011	019
03 17 81	000	000
03 18 81	002	004
03 19 81	000	000
03 20 81	000	006
03 21 81	010	038
03 22 81	000	010
03 23 81	000	016
03 24 81	021	028
03 25 81	040	042
03 26 81	012	010
03 27 81	000	000
03 28 81	002	002
03 29 81	019	046
03 30 81	000	000
03 31 81	021	030
04 01 81	009	012
04 02 81	004	005
04 03 81	000	000
04 04 81	000	000
04 05 81	012	013
04 06 81	000	000
04 07 81	000	000
04 08 81	024	026
04 09 81	005	004
04 10 81	008	000
04 11 81	087	143
04 12 81	028	007
04 13 81	000	000
04 14 81	000	000
04 15 81	014	035
04 16 81	000	000
04 17 81	000	000
04 18 81	000	000
04 19 81	000	000
04 20 81	000	001
04 21 81	000	002
04 22 81	000	000
04 23 81	009	006
04 24 81	000	000
04 25 81	002	002
04 26 81	010	006
04 27 81	011	007
04 28 81	000	000
04 29 81	000	000
04 30 81	000	000
05 01 81	000	000
05 02 81	000	000
05 03 81	000	000
05 04 81	024	036
05 05 81	038	068
05 06 81	002	000
05 07 81	000	000
05 08 81	000	002
05 09 81	000	001
05 10 81	000	000
05 11 81	000	000
05 12 81	000	000
05 13 81	000	000
05 14 81	009	000
05 15 81	020	021
05 16 81	000	000
05 17 81	026	029
05 18 81	033	059
05 19 81	016	012
05 20 81	000	000
05 21 81	000	000
05 22 81	000	000
05 23 81	026	039
05 24 81	044	040
05 25 81	011	013
05 26 81	000	000
05 27 81	000	000
05 28 81	000	000
05 29 81	000	001
05 30 81	004	006
05 31 81	000	000

10

Storm volume comparisons for Eugene and Springfield rain gages: inches x100

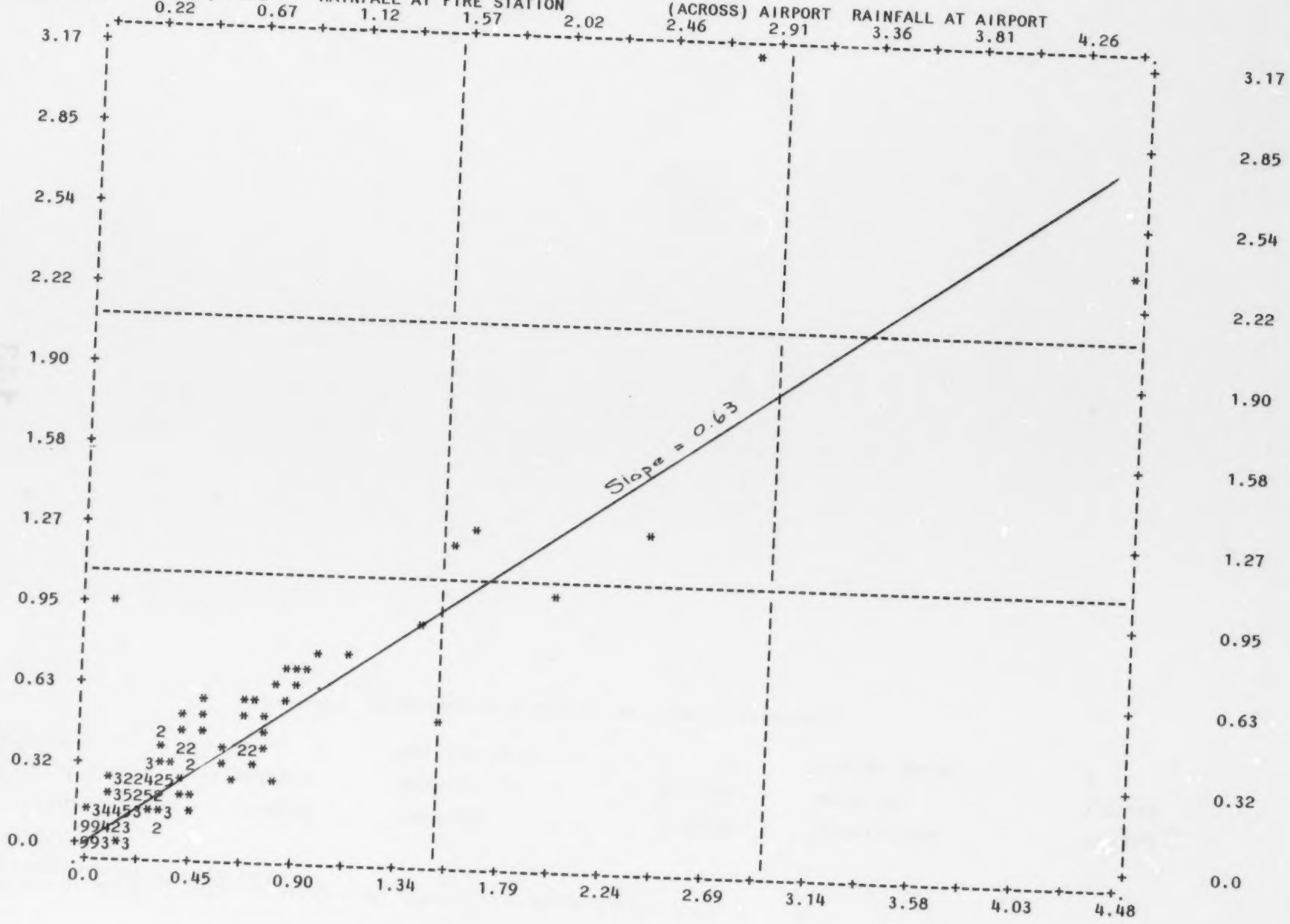
FS	AP	STP	SMY
27	37	31	48
30	93	45	55
17	67	31	20
89	124	74	60
30	71	15	30
52	113	62	90
49	32	67	62
316	387	298	268
15	11	32	
23	25	20	23
16	20	19	12
10	32		20
184	239		175
17	30		10
90	142		110
6	9		20
38	60		50
69	76		30
28	18		100
32	38		20
43	78		50
42	71		115
0	0		10
94	09		30
15	20		0
18	18		0
28	33		50
80	92		230
83	98		120
40	75		40
295	369		330
31	43		20
159	240		190
8	20		10
790	1010		1005
181	217		121
10	8		20
257	340		273
51	41		30
31	26		30
74	110		
66	70	77	80
106	202	170	180
34	47	48	
12	13	14	
152	180	139	
14	35	20	
32	24	49	42
64	104	69	60
104	121	146	106
81	92	111	100
4	6	8	

FS	Eugene fire station
AP	Eugene airport
STP	Springfield treatment plant
SMY	Springfield maintenance yards

```
COMPARISON OF RAINFALL DATA (STORMS)
 GENERAL DESCRIPTIVE STATISTICS OF THE RAINFALL DATA
FILE    NONAME    (CREATION DATE = 05/04/82)

VARIABLE  FS          RAINFALL AT FIRE STATION

MEAN              0.796
VARIANCE          1.519          STD ERROR        0.171          STD DEV         1.233
RANGE             7.900          KURTOSIS        21.830          SKEWNESS        4.186
SUM              41.370          MINIMUM          0.0            MAXIMUM         7.900

VALID OBSERVATIONS -      52                MISSING OBSERVATIONS -       1
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

VARIABLE  AP          RAINFALL AT AIRPORT

MEAN              1.045
VARIANCE          2.486          STD ERROR        0.219          STD DEV         1.577
RANGE            10.100          KURTOSIS        21.386          SKEWNESS        4.108
SUM              54.360          MINIMUM          0.0            MAXIMUM        10.100

VALID OBSERVATIONS -      52                MISSING OBSERVATIONS -       1
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

VARIABLE  STP         SPRINGFIELD

MEAN              0.702
VARIANCE          0.467          STD ERROR        0.146          STD DEV         0.683
RANGE             2.900          KURTOSIS         4.996          SKEWNESS        2.046
SUM              15.450          MINIMUM          0.080          MAXIMUM         2.980

VALID OBSERVATIONS -      22                MISSING OBSERVATIONS -      31
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

VARIABLE  YDS         YARDS

MEAN              0.988
VARIANCE          2.531          STD ERROR        0.237          STD DEV         1.591
RANGE            10.050          KURTOSIS        24.459          SKEWNESS        4.490
SUM              44.450          MINIMUM          0.0            MAXIMUM        10.050

VALID OBSERVATIONS -      45                MISSING OBSERVATIONS -       8
```

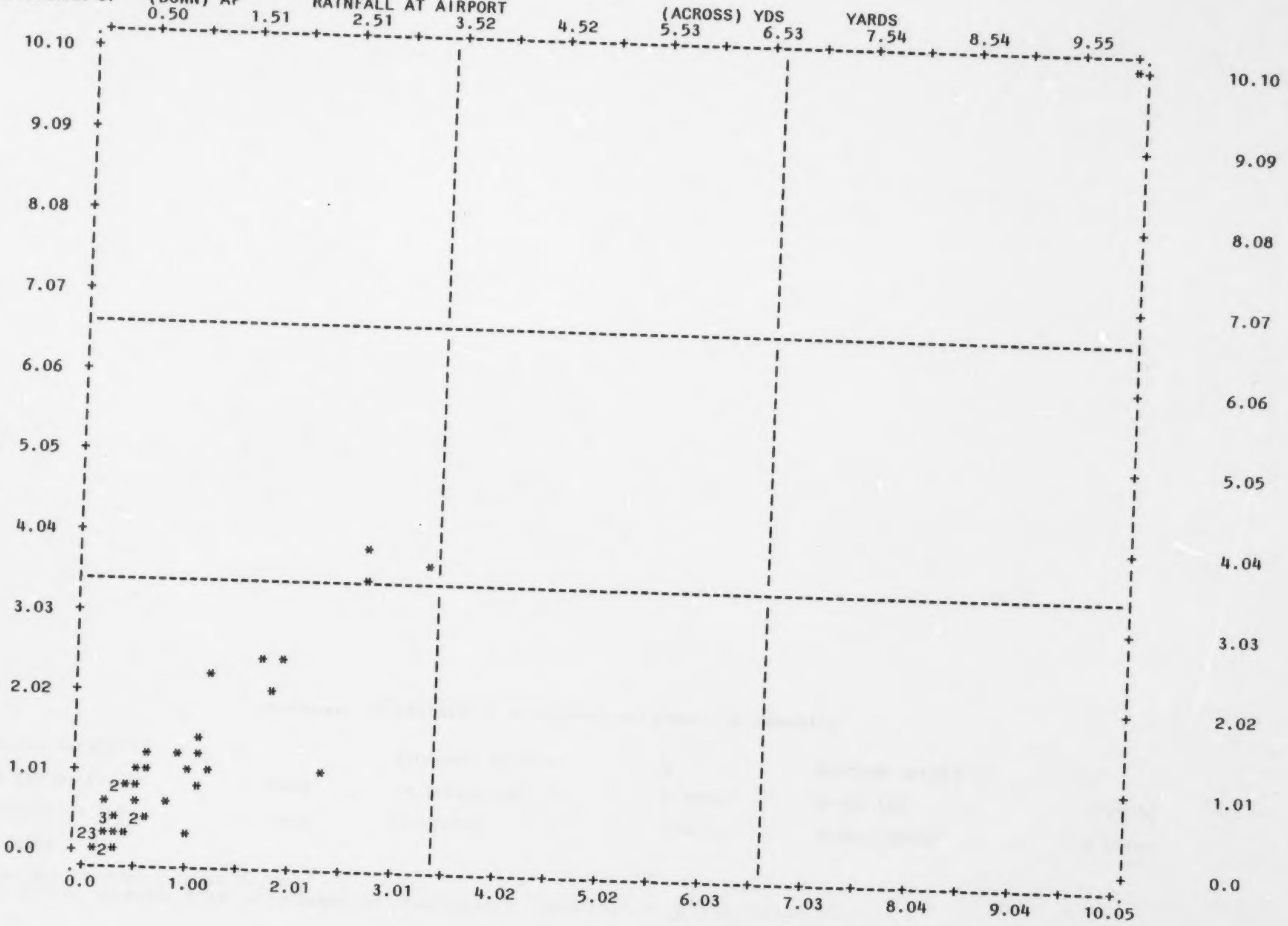
```
COMPARISON OF RAINFALL DATA --- AIRPORT VS. FIRE STATION (DAILY)
SCATTERGRAM OF DATA AT BOTH SITES

STATISTICS..

  CORRELATION (R)-        0.90166     R SQUARED        -      0.81299     SIGNIFICANCE   -      0.00000
  STD ERR OF EST -        0.15414     INTERCEPT (A)  -        0.03439     SLOPE (B)      -      0.63355
  PLOTTED VALUES -      193           EXCLUDED VALUES-        0           MISSING VALUES -      0

                    '********' IS PRINTED IF A COEFFICIENT CANNOT BE COMPUTED.
```

COMPARISON OF RAINFALL DATA --- AIRPORT VS. FIRE STATION (DAILY)
SCATTERGRAM OF DATA AT BOTH SITES
FILE NONAME (CREATION DATE = 04/14/82)
SCATTERGRAM OF (DOWN) FIRE RAINFALL AT FIRE STATION (ACROSS) AIRPORT RAINFALL AT AIRPORT



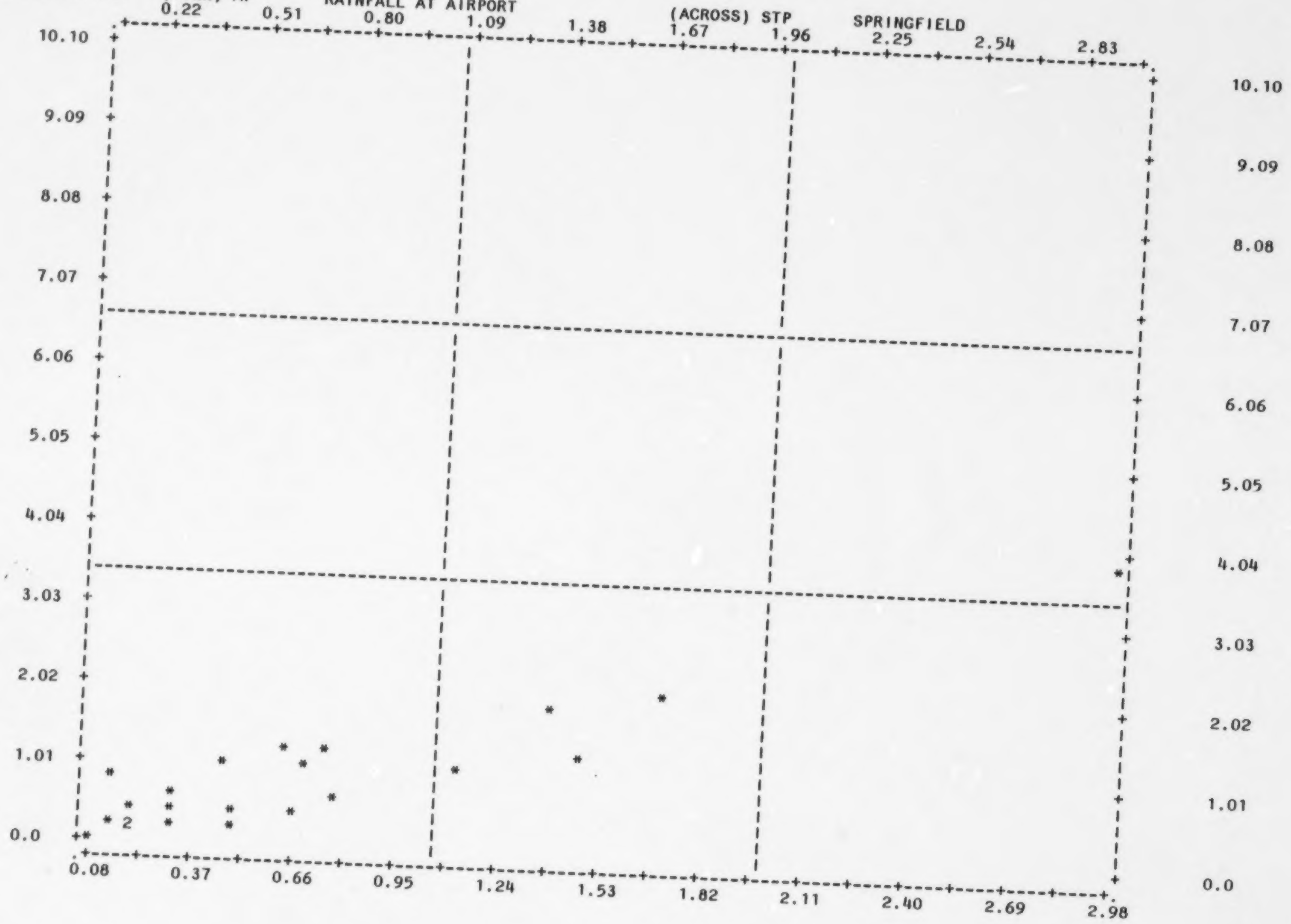
```
COMPARISON OF RAINFALL DATA --- AIRPORT VS. SPRINGFIELD YARDS (STORMS)
SCATTERGRAM OF DATA AT BOTH SITES

STATISTICS..

  CORRELATION (R)-       0.96716     R SQUARED      -       0.93539     SIGNIFICANCE   -         0.00000
  STD ERR OF EST -       0.42900     INTERCEPT (A)  -       0.11664     SLOPE (B)      -         1.01443
  PLOTTED VALUES -      45           EXCLUDED VALUES-       0           MISSING VALUES -         8

                  '*********' IS PRINTED IF A COEFFICIENT CANNOT BE COMPUTED.
```

```
COMPARISON OF RAINFALL DATA --- AIRPORT VS. SPRINGFIELD MAINTENANCE YARDS   (STORMS)
SCATTERGRAM OF DATA AT BOTH SITES
FILE   NONAME   (CREATION DATE = 05/04/82)
SCATTERGRAM OF   (DOWN) AP        RAINFALL AT AIRPORT              (ACROSS) YDS      YARDS
```



```
COMPARISON OF RAINFALL DATA --- AIRPORT VS. SPRINGFIELD TREATMENT PLANT (STORMS)
SCATTERGRAM OF DATA AT BOTH SITES

STATISTICS..

  CORRELATION (R)-          0.93687      R SQUARED       -         0.87773      SIGNIFICANCE    -         0.00000
  STD ERR OF EST -          0.30906      INTERCEPT (A)   -         0.02099      SLOPE (B)       -         1.18306
  PLOTTED VALUES -         22            EXCLUDED VALUES-          0            MISSING VALUES  -        30

                          '********' IS PRINTED IF A COEFFICIENT CANNOT BE COMPUTED.
```

```
COMPARISON OF RAINFALL DATA --- AIRPORT VS. SPRINGFIELD TREATMENT PLANT  (STORMS)
SCATTERGRAM OF DATA AT BOTH SITES
FILE   NONAME   (CREATION DATE = 05/04/82)
SCATTERGRAM OF    (DOWN) AP          RAINFALL AT AIRPORT
```



APPENDIX B

FLOW DATA

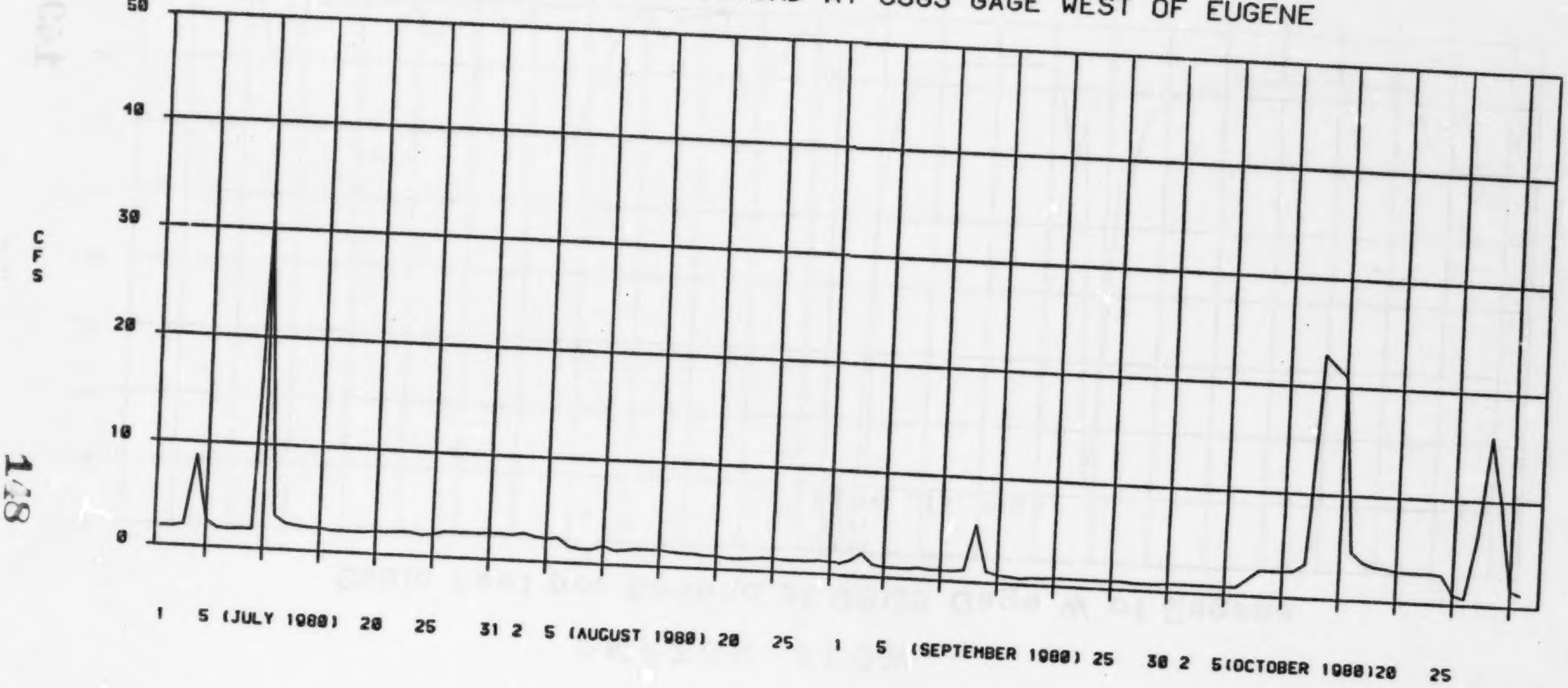
CONTENTS

Average Daily Flow at the Amazon Channel - USGS Continuous Gage

Eugene: Channel Flow Measurements and Rating Curves

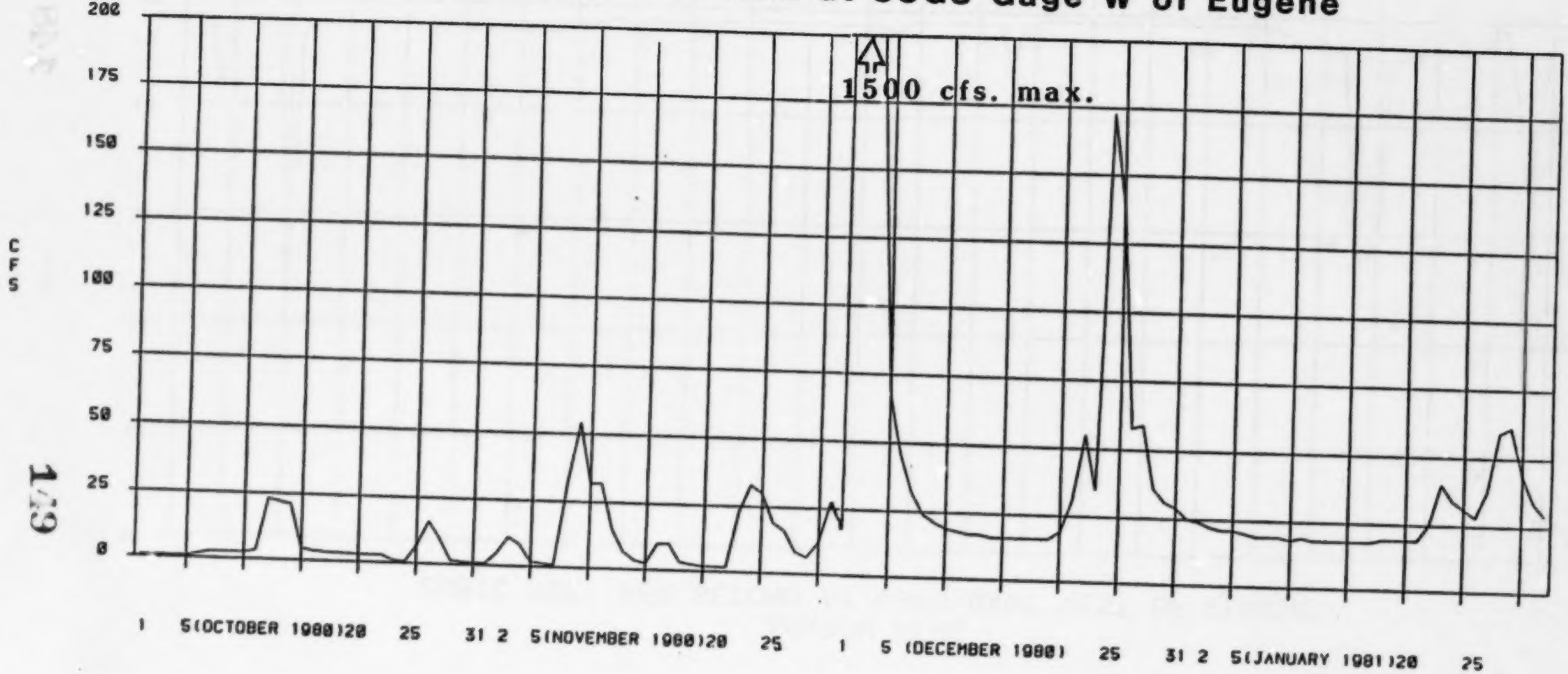
Springfield: Channel Flow Measurements and Rating Curves

AMAZON FLOW
CUBIC FEET PER SECOND AT USGS GAGE WEST OF EUGENE



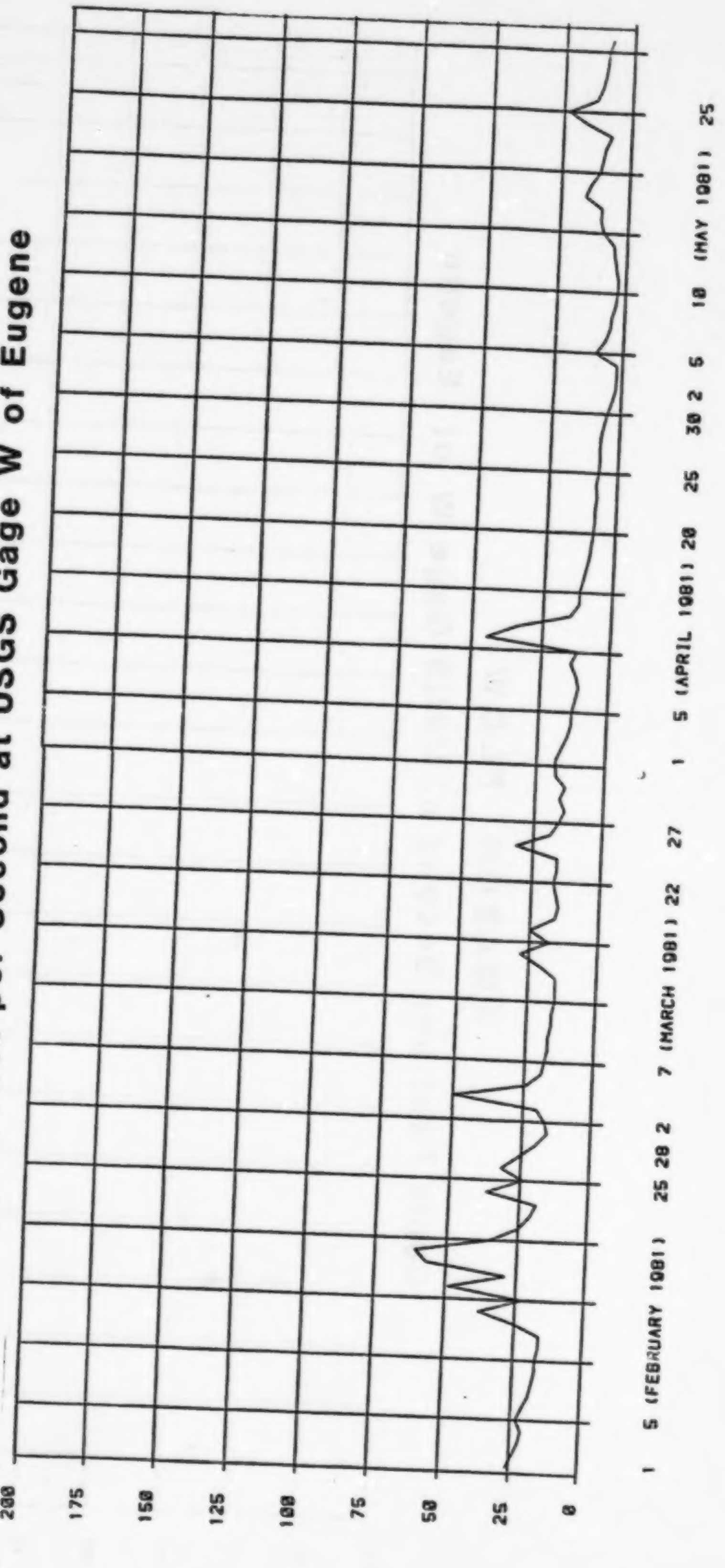
AMAZON FLOW

Cubic Feet per Second at USGS Gage W of Eugene



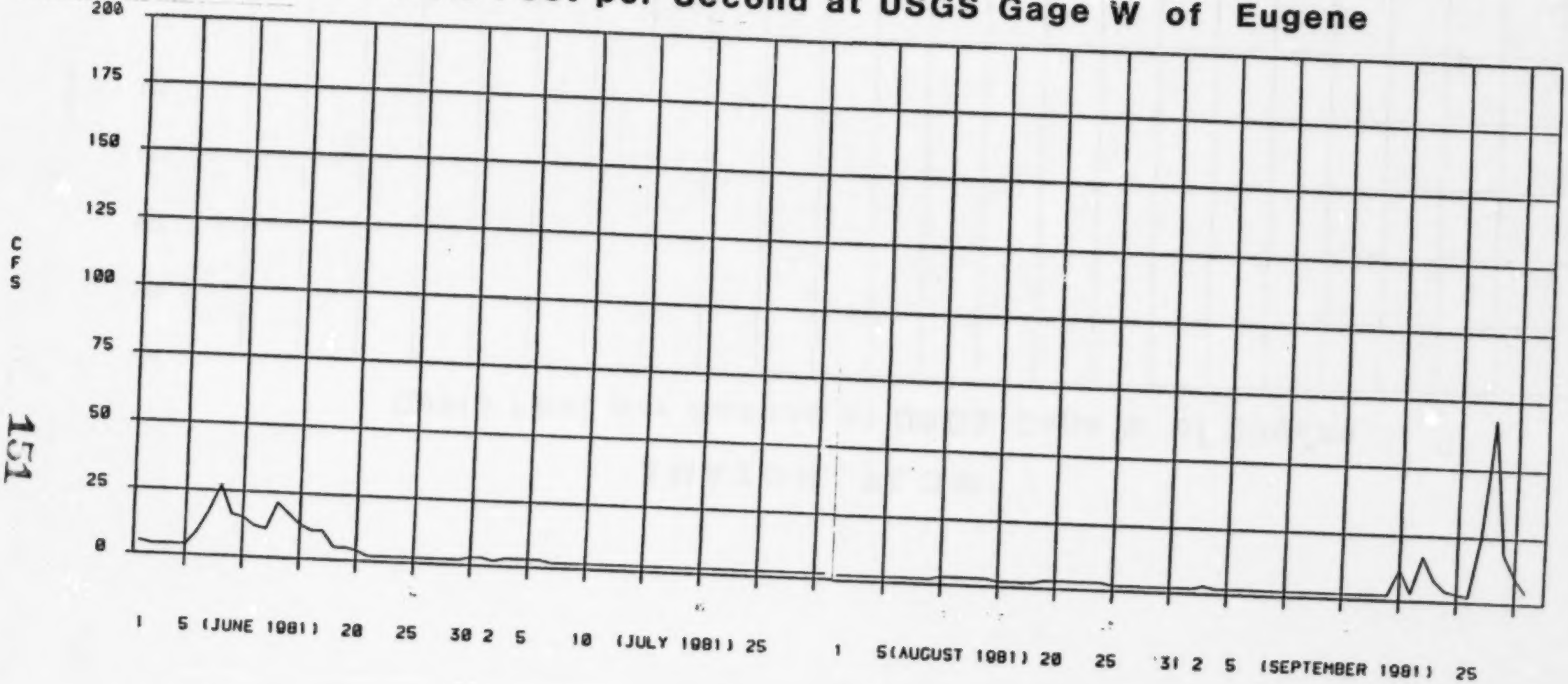
AMAZON FLOW

Cubic Feet per Second at USGS Gage W of Eugene



AMAZON FLOW

Cubic Feet per Second at USGS Gage W of Eugene

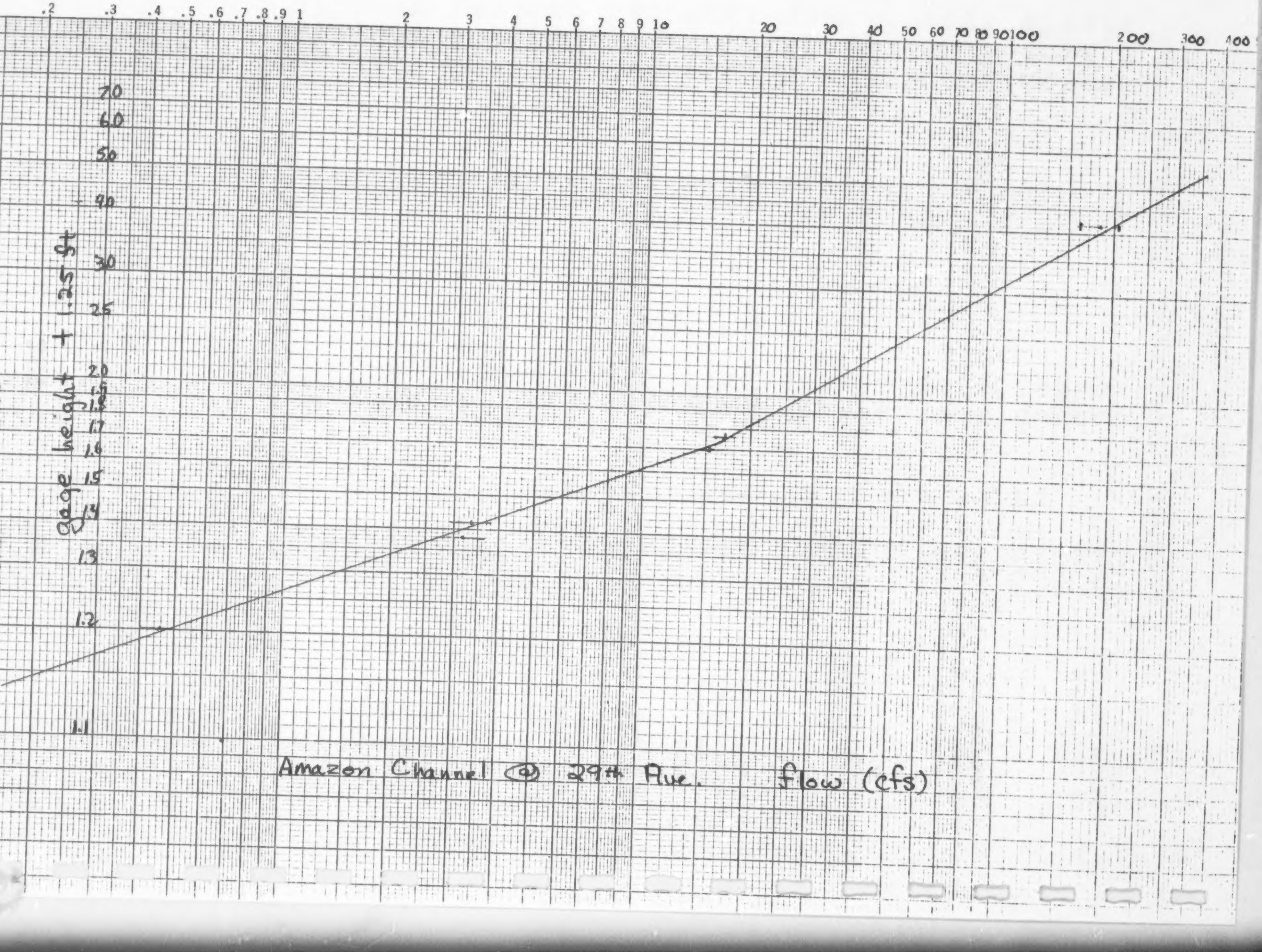


FLOW MEASUREMENTS - EUGENE

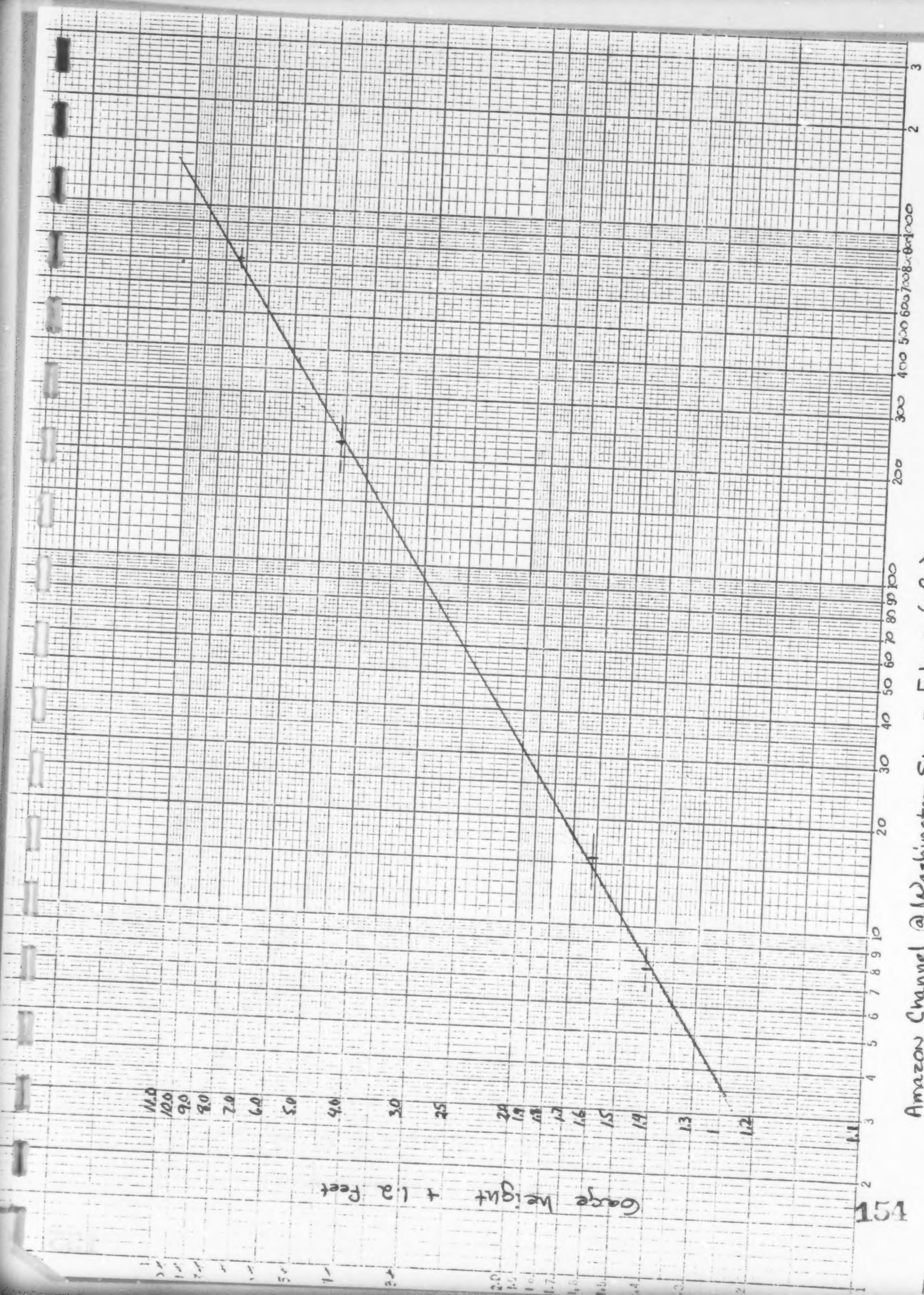
Station	Gage Reading	Calculated Flow	Error/Comment	Date
E-AMD-29	0.170	3.38	0.40	01-21-80
Amazon Channel	0.130	3.18	0.40	03-24-80
@ 29th Avenue	0.450	15.30	1.20	04-07-80
	0.510	16.90	1.00	07-10-80
	-0.050 ± .01	0.45	0.05	08-28-80
	2.900 ± .08	183.00	23.00	12-02-80
E-AMD-WA	3.400 ± .05	220.00	40.00/a	01-14-80
Amazon Channel	0.220 ± .02	7.60	1.00	01-21-80
@ Washington	0.410	15.60	3.00	04-07-80
	7.050 ± .10	714.00	49.00/b	12-03-80
E-AMD-OP	0.300	8.40	1.00	01-21-80
Amazon Channel	0.130	4.00	0.50	02-13-80
@ Oak Patch Rd.	0.570	19.90	3.00	04-07-80
	0.020	1.20	0.20	09-29-80
	4.950 ± .15	548.00	38.00	12-02-80
	0.980	31.60	6.70	12-22-80
E-POLK	0.460 ± .01	4.90	0.50/c	11-21-80
Polk Street	0.480 ± .01	5.30	0.50/c	11-21-80
Storm Sewer	3.200 ± .20	40.50	5.00	12-03-80
Outfall	0.230	1.32	0.30	12-18-80
E-AC-A2GG	1.850	94.00	20.00/a	01-14-80
A-2 Ditch	0.700	7.05	1.2	01-21-80
@ Golden Gardens	0.400	1.93	0.40	02-13-80
E-AC-A3WAL	-1.500 ± .02	2.75	0.10	01-21-80
A-3 Ditch	-1.590 ± .02	1.67	0.10	03-24-80
@ Wallis Rd.	-0.570	3.75	0.30	04-07-80
	-0.280	4.20	0.30	07-10-80
	0.765	0.98	+1,-.50/e	09-29-80
	1.590	52.00	5.30	12-02-80
	0.450	0.50	f	01-14-81
E-AC-A3BER	2.600	55.00	10.00/a	01-14-80
A-3 Ditch	0.220	4.80	1.00/a	01-21-80
@ Bertelsen Rd.	0.400	5.50	0.80	04-07-80
	0.410	0.86	0.20/g	09-29-80
	0.730	3.80	0.40/g	11-21-80
	3.550	62.60	5.00	12-02-80
	0.540	1.33	0.20	01-14-81
	1.360	19.00	1.60	02-13-81
	0.790	3.60	0.30	03-16-81

---

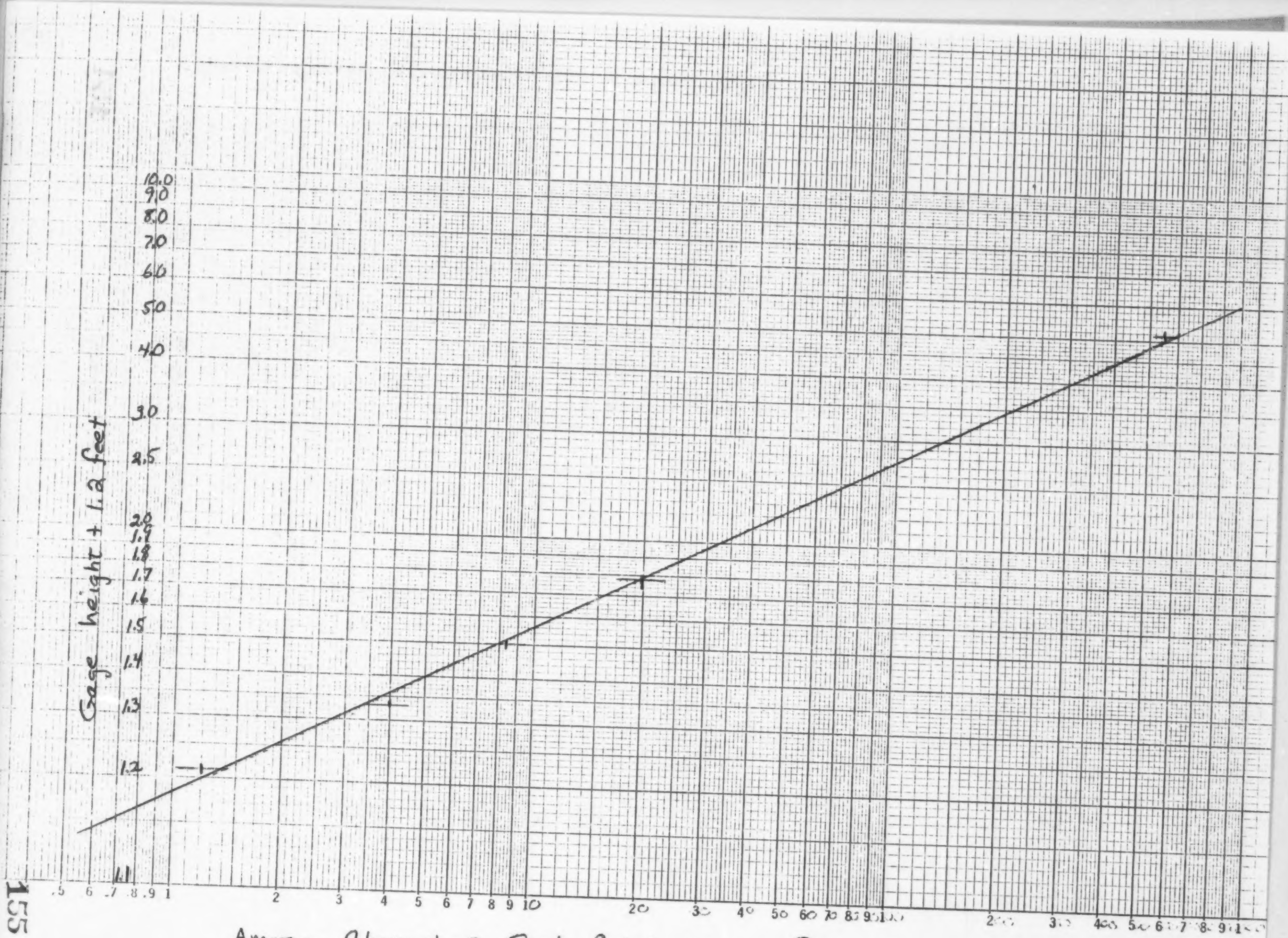
a - Based on minimal flow readings
b - Flow falling
c - Flow rising
d - Beaver began building dam
e - Large cross-section
f - Large cross-section; no flow detectable
g - Vegetation in control



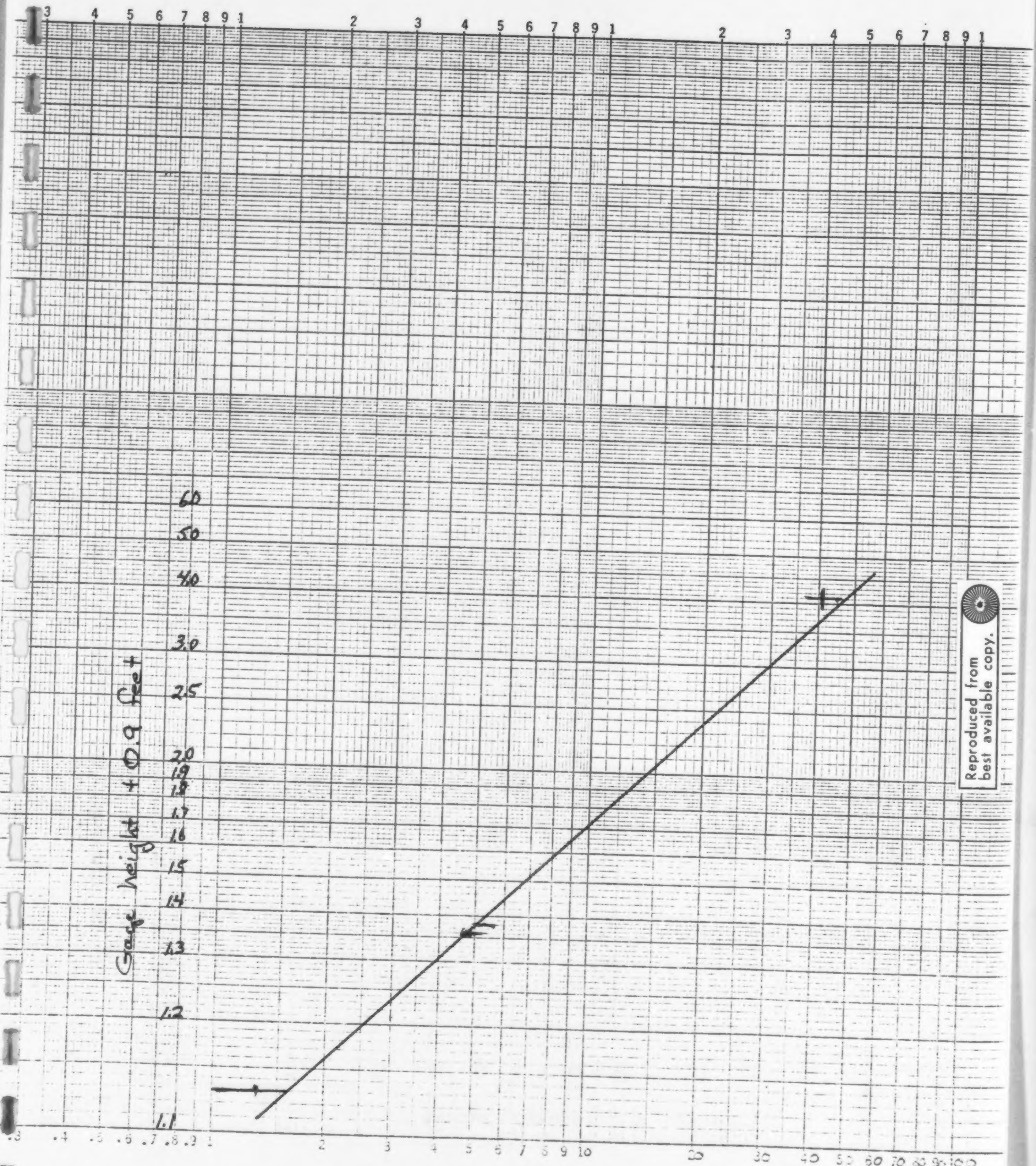
Amazon Channel @ 29th Ave.



Reproduced from best available copy.

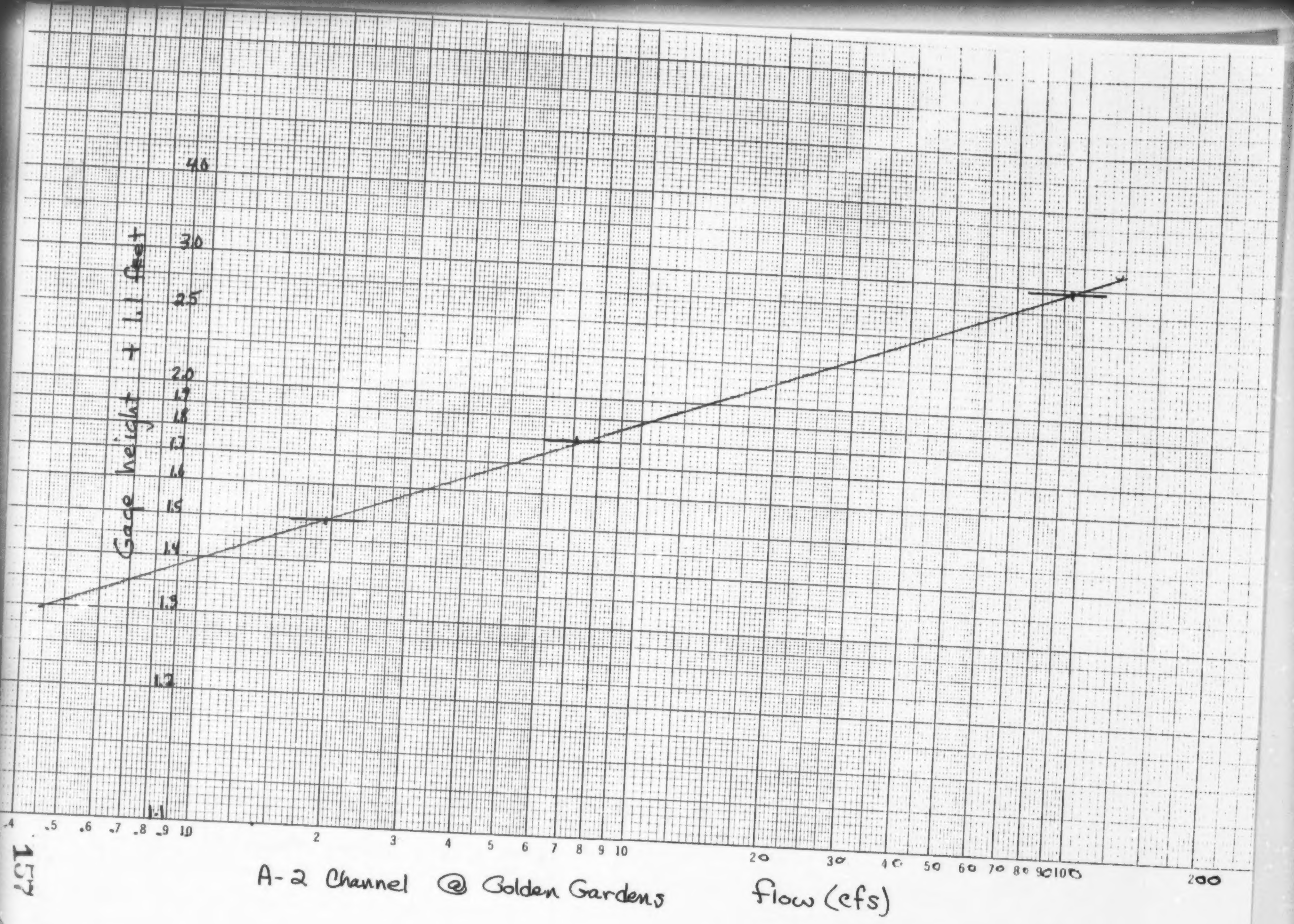


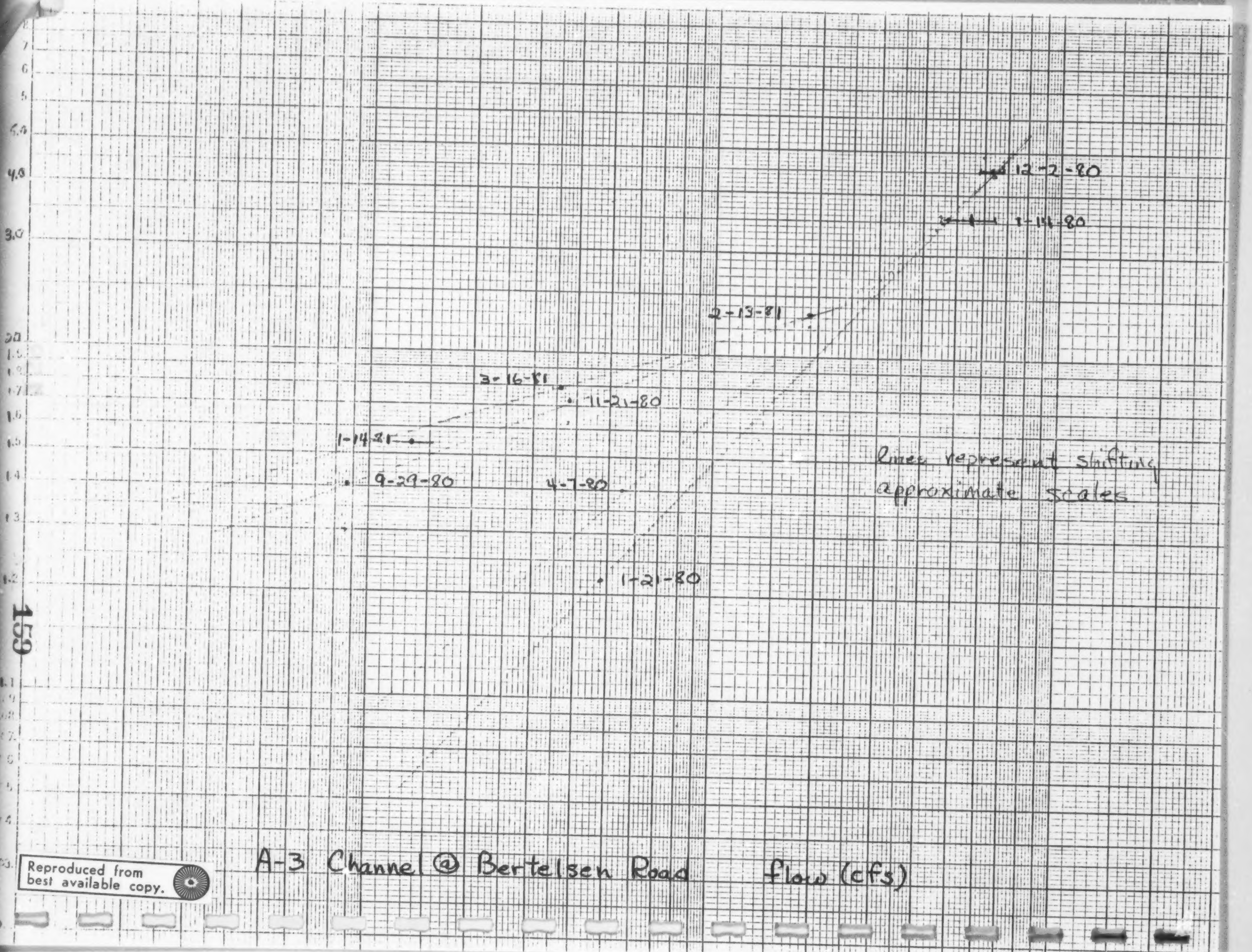
Amazon Channel @ Oak Patch Rd



Reproduced from best available copy.

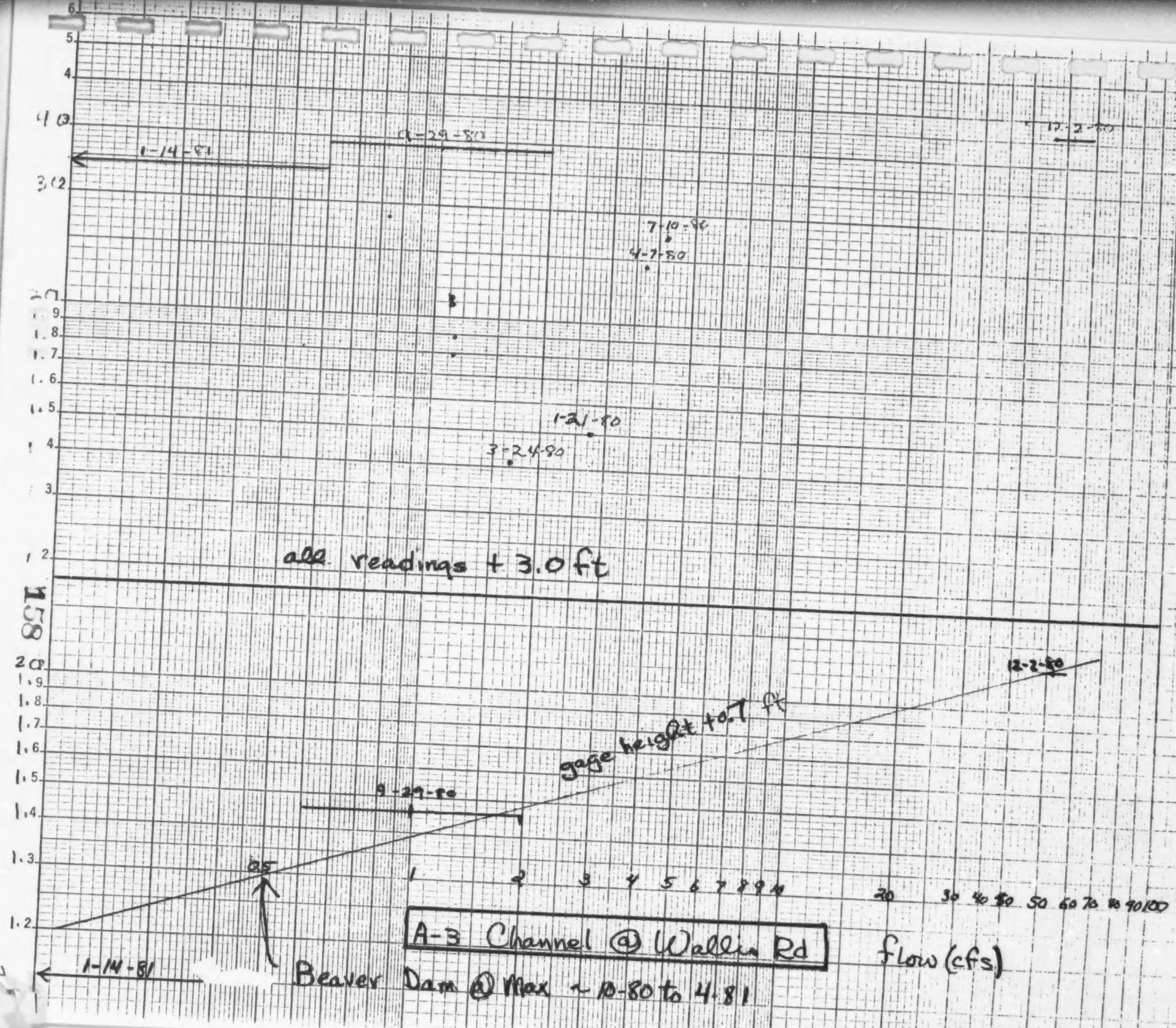
POLK STORMSEWER @ Overflow structure flow (cfs)


A-2 Channel @ Golden Gardens



A-3 Channel @ Bertelsen Road

Reproduced from best available copy.

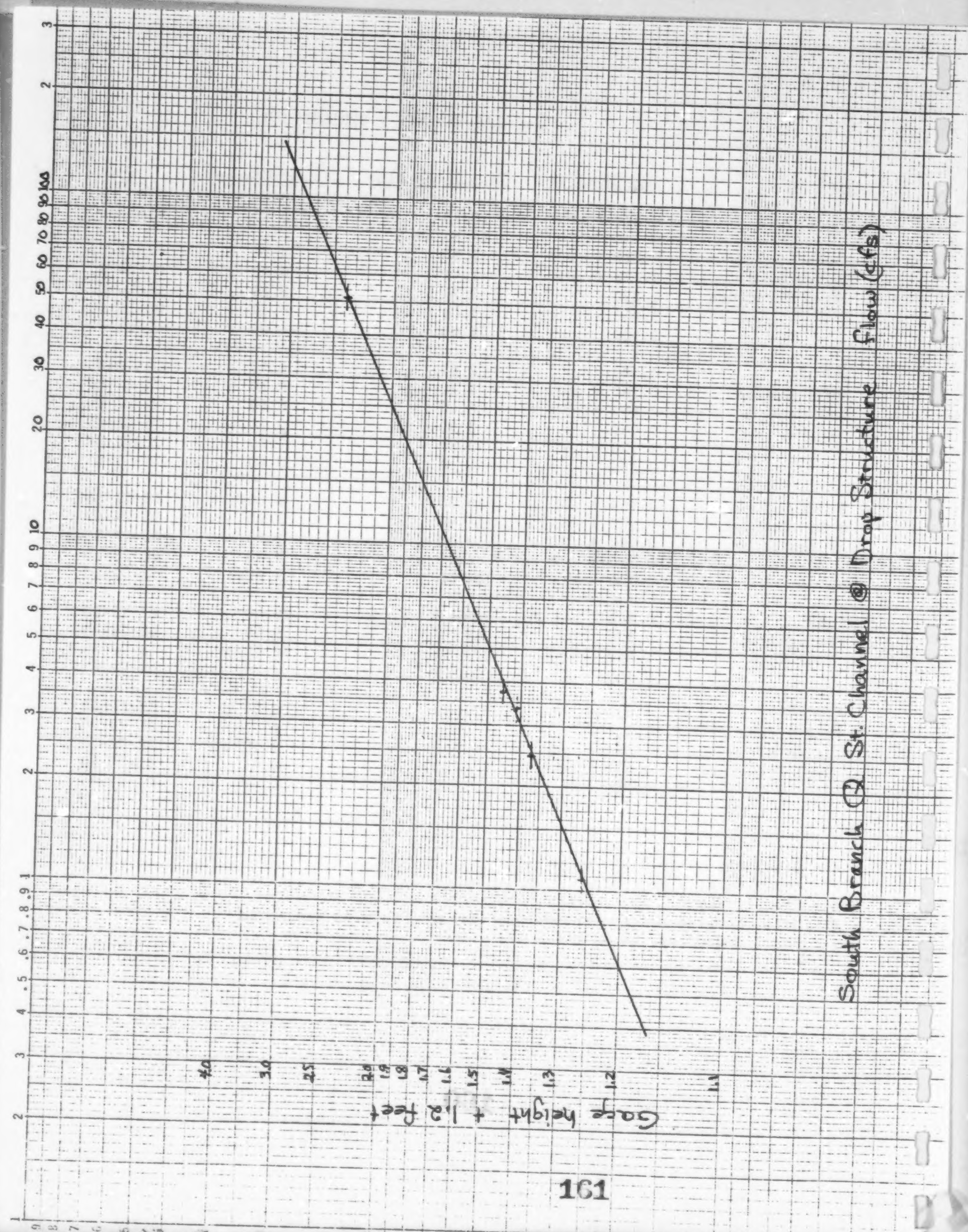

6
5
4
4 0
3 2
2 0
1.9
1.8
1.7
1.6
1.5
1.4
3
2
2 0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1-14-81
9-29-80
12-2-80
7-10-80
4-7-80
1-21-80
3-24-80
all readings + 3.0 ft
12-2-80
gage height +0.7 ft
9-29-80
0.5
1
2
3
4
5
6
7
8
9
10
20
30
40
50
50
60
70
80
90
100
A-3 Channel @ Wallis Rd
flow (cfs)
1-14-81
Beaver Dam @ Max ~ 10-80 to 4-81

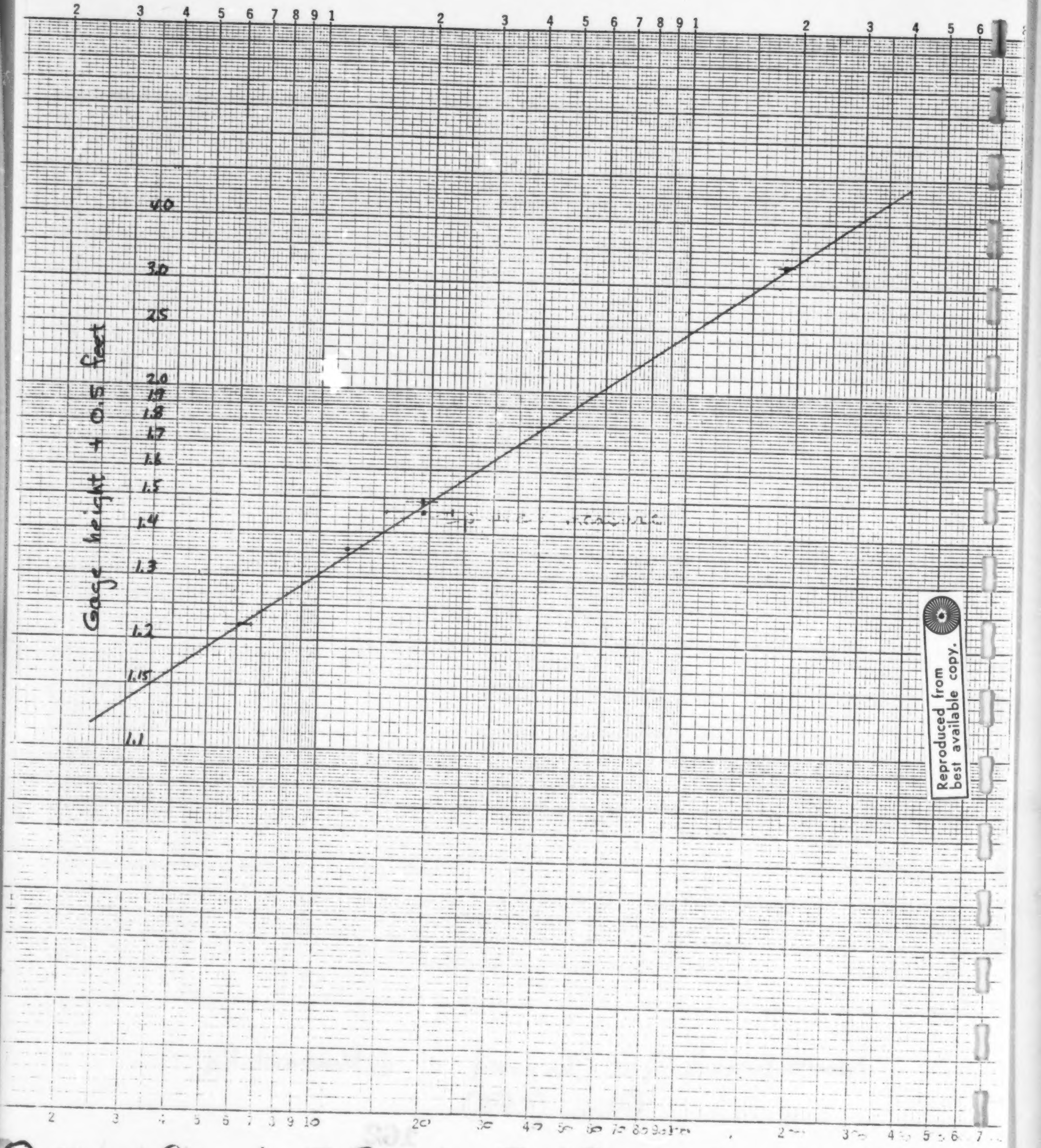
FLOW MEASUREMENTS - SPRINGFIELD

Station	Gage Reading	Calculated Flow	Error/Comment	Date
S-Q-SB	0.620 ± .05	16.70 if 10' 14.60 if 9'	± 3.00	01-14-80
South Branch Q Channel @ Drop Structure	0.210 ± .03	3.36	0.30	01-21-80
	0.170 ± .01	2.47	0.20	03-24-80
	0.250	3.74	0.30	07-10-80
	0.060	1.08	0.10	08-28-80
	1.180	51.00	4.00	12-02-80
S-Q-NB North Branch Q Channel @ Mohawk	0.380	2.04	0.20	02-13-80
	0.740 ± .02	8.10	0.80	03-24-80
	0.630 ± .01	6.40	0.60	04-07-80
	0.040	2.50	0.20/a	08-28-80
	1.220 ± .05	22.50	2.00	12-03-80
	0.250	4.10	0.40	01-17-81
S-Q-2 Q St. Channel @ 2nd St.	0.960 ± .01	19.30	4.00/b	01-21-80
	0.860 ± .01	11.90	2.00	03-24-80
	0.990 ± .01	19.30	1.50	04-07-80
	0.720 ± .01	6.10	0.50	08-28-80
	2.740 ± .07	184.00	9.00/c	12-03-80
S-MR Springfield Mill Race	0.800	149.00	20.00	07-10-80
	0.520	98.00	9.00	08-28-80
	1.850	375.00	70.00/d	12-02-80
	0.100	31.50	3.10	01-21-81
S-CC-72TH 72nd Street Ditch @ Drop Structure	1.410 ± .02	31.80	2.00	01-14-80
	0.520	1.02	e	02-13-80
	1.580 ± .02	43.00	3.00/c	12-02-80
	0.475	0.22	0.05	01-21-80
	0.750	3.90	0.40	01-27-81

---

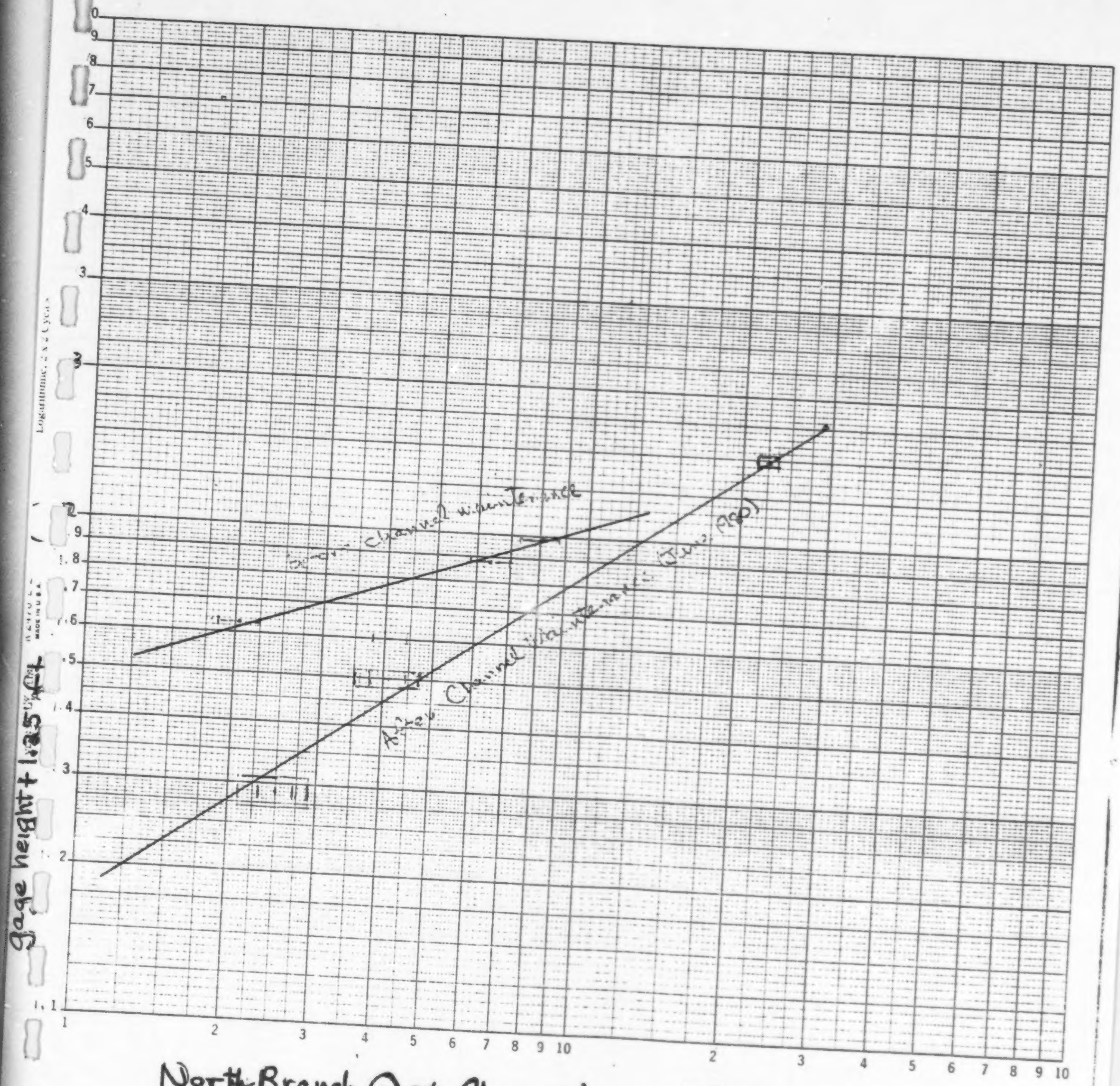
a - Ditch was cleared
b - Measured at a poor site
c - Flow rising
d - Meter shorted out two-thirds way through; results projected
e - Small amount of ice in ditch


South Branch (2) St. Channel @ Drop Structure flow (cfs)
Gage height + 1.2 feet
2.0
3.0
2.5
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
.4
.5
.6
.7
.8
.9
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100

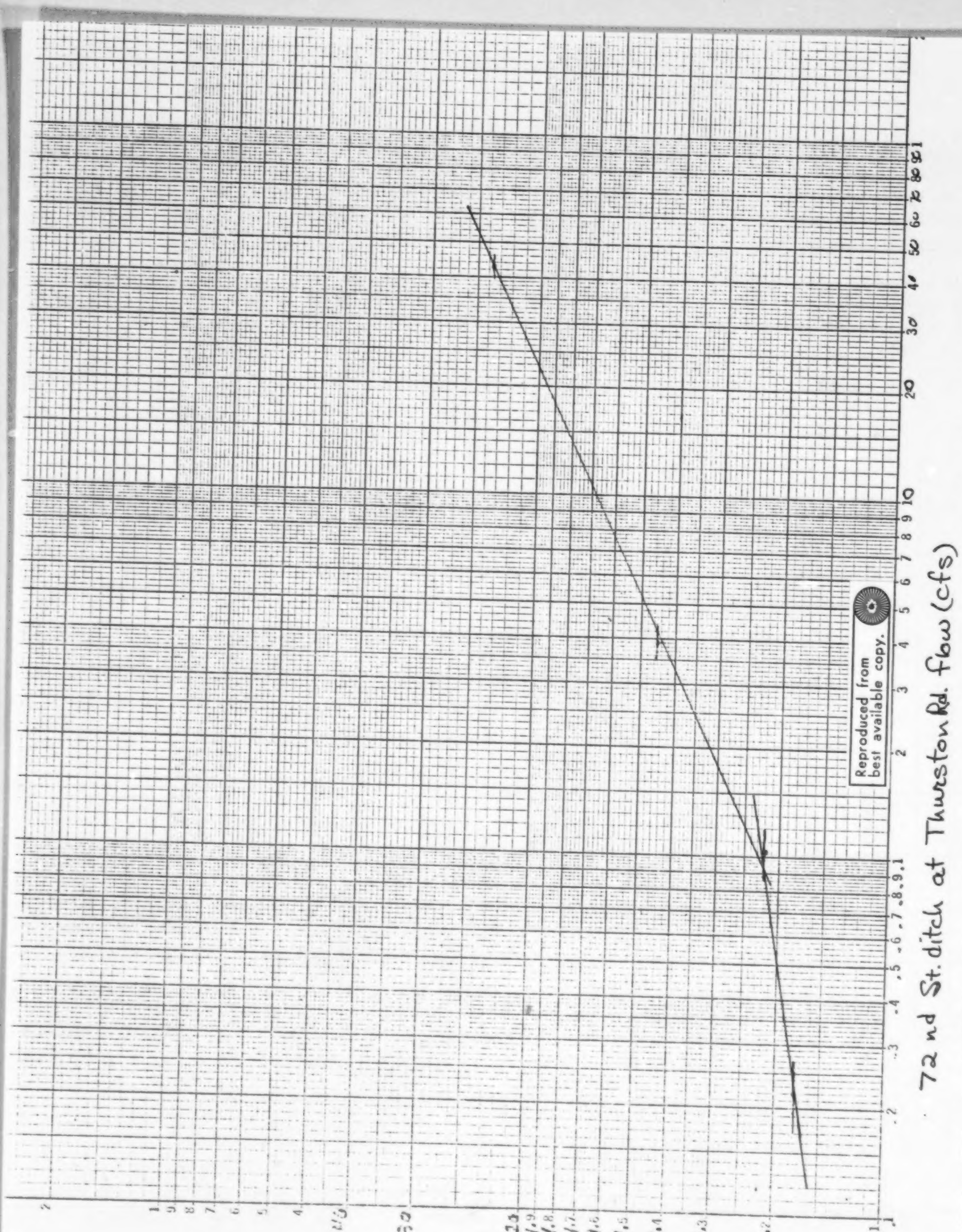


Reproduced from best available copy.

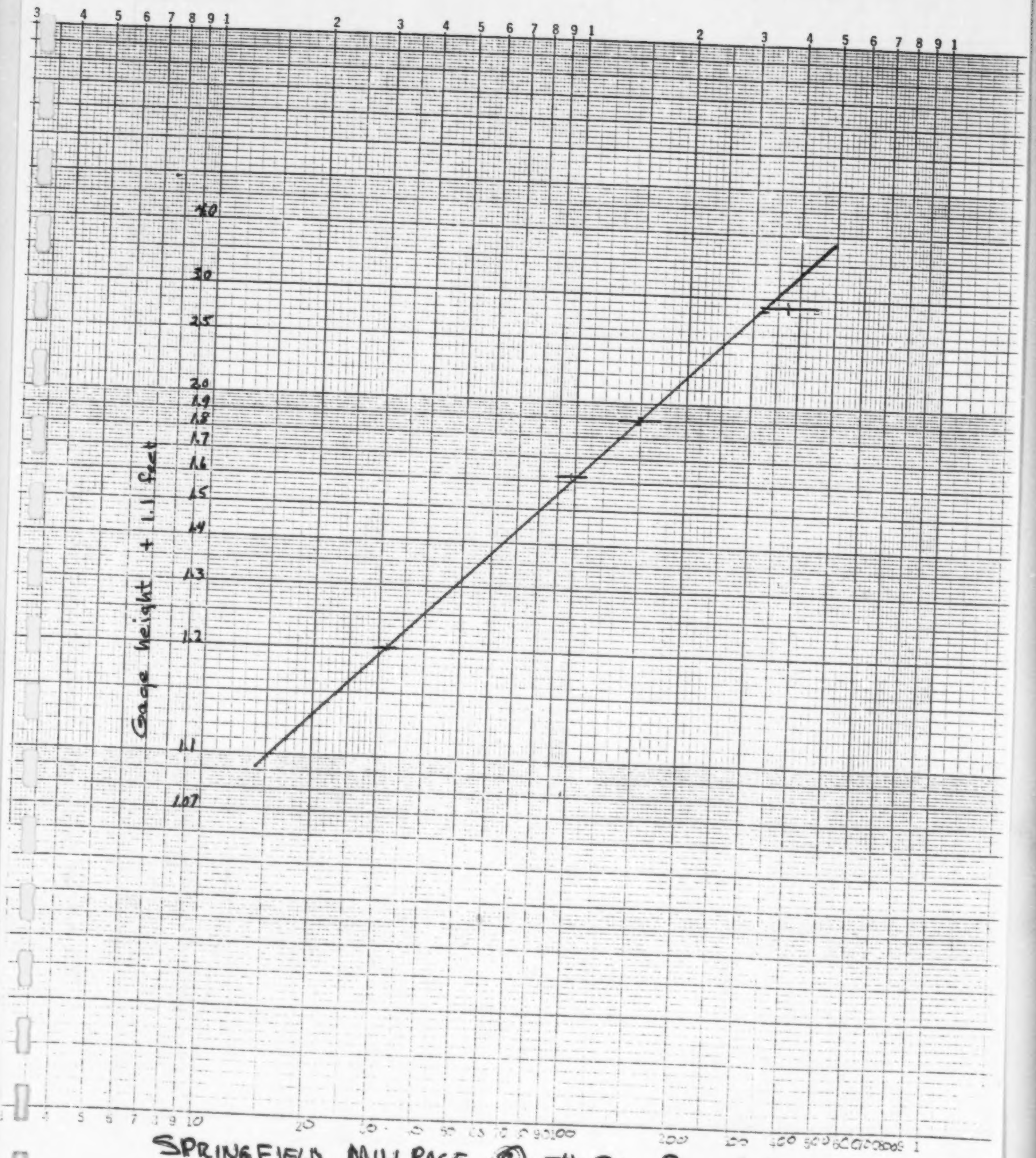
Q street Channel @ Second and Third Street flow (cfs)



North Branch Qst Channel @Mowhawk Rd.
Flow (CFS)



Reproduced from best available copy.



SPRINGFIELD MILLRACE @ 5th St flow (cfs)

APPENDIX C

WATER QUALITY DATA

CONTENTS

Urban Runoff Sampling Guidelines

L-COG NURP Monitoring Station - STORET Access Data

Water Quality Monitoring Schedule

Testing Procedures, Accuracies, and Precisions

STORET Retrieval of NURP Water Quality Statistics

Eugene Storm Data Catalog

Springfield Storm Data Catalog

URBAN RUNOFF SAMPLING GUIDELINES

April 11, 1980

Most of the suggestions summarized here were suggested by U.S. Geological Survey and EPA National Urban Runoff staff at a recent "Urban Hydrology" Workshop at the U.S.G.S. Training Center in Denver.

SAMPLE REPRESENTATIVES

Since the water flowing past the sample site varies in quality from top to bottom and moment to moment, it is important to try and get a sample that is representative. Ideally, it would be nice to take three to five samples from various parts of the stream, composit them and use part of the averaged sample. Since that is not possible, care must be given to when and where the sample is collected. The list of things to avoid:

- Influence of discharges immediately upstream
- Surface samples
- Bottom samples
- Disturbing the bottom or upstream flow pattern
- Eddy or backwater samples
- Standing in front of or too close to sample bottle while filling

Things to look for:

- Try to sample in the major current
- Try to sample at about mid-depth
- Try to sample where the channel looks well mixed -- below a drop or where turbulence is best
- Should be 20 feet below major head changes

Since pollutant loading is the product of flow and concentration, careful gage reading is important. The gage needs to represent the same time as the sampling. If the stream is rising rapidly, record the gage height and time before and after sampling. Since water often piles up or drops against the gage, record the height most representative of the general incoming flow level.

Gage level at drop structures should be read at the upstream water level where the fall drawdown is not significant -- normally at the upstream side of gage. Flow estimations are only ±20 percent accurate and so the gage reading should be better than ±0.1 feet at high flow and ±0.02 feet at low flow, since small gage differences can represent significant flow changes.

SPECIAL CONCERNS

Samples for pesticides and bacteria should be cleaned and handled very carefully to avoid contamination.

Field Blanks -- at least every other sample trip, one complete set of sample bottles should be filled with distilled water, taken out in the field, opened and let stand for ten minutes while sampling is going on, closed and brought back to be tested.

Duplicates -- the basic rule is one duplicate for each ten samples but this is not an absolute rule. Each bottle type and its "duplicate" should be filled simultaneously to avoid stream concentration errors.

Remember -- personal safety is more important than any sample.

SPECIAL CONCERNS

Samples for pesticides and bacteria should be cleaned and handled very carefully to avoid contamination.

Field Blanks -- at least every other sample trip, one complete set of sample bottles should be filled with distilled water, taken out in the field, opened and let stand for ten minutes while sampling is going on, closed and brought back to be tested.

Duplicates -- the basic rule is one duplicate for each ten samples but this is not an absolute rule. Each bottle type and its "duplicate" should be filled simultaneously to avoid stream concentration errors.

Remember -- personal safety is more important than any sample.

L-COG NURP MONITORING STATIONS

STORET ACCESS DATA

Agency Code: 10EPACOP
Location: Lane County, Oregon

STATION LOCATION	STATION CODES		
	Code 1	Code 2	Code 3
Amazon near Terry Street	208LCOG-0007	WQ0007	E-AMD-VEG-1
Amazon near Danebo Road	208LCOG-0008	WQ0008	E-AMD-VEG-2
Amazon near Willow Creek	208LCOG-0009	WQ0009	E-AMD-VEG-3
Amazon at Oak Patch Road	208LCOG-0008	WQ0010	E-AMD-OP
Amazon at Washington Street	208LCOG-0011	WQ0011	E-AMD-WA
Amazon at 29th Avenue	208LCOG-0012	WQ0012	E-AMD-29
A-2 Channel @ Golden Gardens	208LCOG-0013	WQ0013	E-AC-A2GG
A-3 Channel @ Bertelsen Road	208LCOG-0014	WQ0014	E-AC-A3BER
A-3 Channel @ Wallis Road	208LCOG-0015	WQ0015	E-AC-A3WAL
Polk Street Storm Sewer Outfall	208LCOG-0016	WQ0016	E-POLK
Eugene Millrace @ Mill Street	208LCOG-0017	WQ0017	E-MR
Willamette @ Valley River Bdg	208LCOG-0018	WQ0018	E-WIL-VRB
Willamette @ Autzen Bridge	208LCOG-0020	WQ0020	E-WIL-AB
Willamette @ Highway 126	208LCOG-0021	WQ0021	S-WIL-126
Springfield Millrace @ Mouth	208LCOG-0022	WQ0022	S-MR
Q Street Channel @ Centennial Rd.	208LCOG-0023	WQ0023	S-Q-SKP
Q Street Channel @ Garden Way	208LCOG-0024	WQ0024	S-Q-GW
Q Street Channel @ Second Street	208LCOG-0025	WQ0025	S-Q-2
No. Branch Q St.@ Mohawk Rd.	208LCOG-0026	WQ0026	S-Q-NB
So. Branch Q St.@ Drop Structure	208LCOG-0027	WQ0027	S-Q-SB
72nd St. Channel @ Thurston Road	208LCOG-0028	WQ0028	S-CC-72TH
Amazon @ 29th Sediment Trap	208LCOG-0029	WQ0029	E-AMD-29ST
Marcola Rd. Ditch BLW Oil Trap	208LCOG-0030	WQ0030	S-Q-NBMAR1
Marcola Rd. Ditch ABV Oil Trap E.	208LCOG-0031	WQ0031	S-Q-NBMAR2
Q Street Channel @ Quinalt	208LCOG-0032	WQ0032	S-Q-QN
Marcola Rd. Ditch ABV Oil Trap W.	208LCOG-0033	WQ0033	S-Q-NBMAR3

WATER QUALITY MONITORING SCHEDULE

SITE CODE	PERSONNEL[1]	FREQUENCY	BOTTLES[2]	FLOW
E-AMD-VEG-1	Eugene	Monthly, Storms, special Veg. as needed	A,BOD,B,M,E	USGS
E-AMD-VEG 2	Eugene	Storms, special veg as needed	A,BOD,B,M,E	USGS
E-AMD-VEG-3	Eugene	Storms special veg as needed	A,BOD,B,M,L	USGS
E-AMD-OP	Eugene	Semi-monthly	A,B,M	Read Gage
E-AMD-WA	Eugene	Monthly, semi-monthly, storms	A,BOD,B,M,E	Read Gage
E-AMD-29	Eugene	Monthly	A,BOD,B,M,E	Read Gage
E-AC-A2GG	Eugene	Semi-monthly	A,M	Read Gage
E-AC-A3BER	Eugene	Monthly/Storms	A,BOD,M,E	Read Gage
E-AC-A3WAL	Eugene	Monthly/Storms	A,BOD,M,E	Read Gage
E-POLK	Eugene	Semi-monthly storms	A,BOD,M,E	Read Gage
E-MR	Eugene	Semi-monthly	A,B,M	Estimate
E-WIL-VRB	L-COG	Monthly	A,BOD,B,M	Use EWEB
E-WIL-AB	L-COG	Semi-monthly	A,B,M	Use EWEB
S-WIL-126	L-COG	Monthly	A,BOD,B,M	Use EWEB
S-MR	Springfield	Semi-monthly/storm	A,BOD,B,M,E	Read Gage
S-Q-SKP	Springfield	Semi-monthly	A,B,M	None
S-Q-GW	Springfield	Monthly/storm	A,BOD,B,M,E	Read USGS
S-Q-2	Springfield	Monthly/storm	A,BOD,B,M,E	Read Gage
S-Q-NB	Springfield	Semi-monthly	A,BOD,M	Read Gage
S-Q-SB	Springfield	Semi-monthly/storm	A,BOD,M	Read Gage
S-CC-72TH	Springfield	Semi-monthly	A,BOD,M	Read Gage

[1] Eugene Personnel: Michael Wilson, Paul McNamara
L-COG Personnel: Becky Kreag
Springfield Personnel: Ken Vanderford

[2] A - Basic Chemistry 2 l. plastic bottle
BOD - 2 BOD bottles and fixing agents
B - Bacteria - 250 ml brown bottle
M - Metals/Toxics - 1 - plastic cubitainer
E - Special bottles as directed for Pesticide (P) clear glass bottle
Oil & Grease (G) brown glass bottles and TOC-TKN (G or T) glass or cubitainer.

28

NATIONWIDE URBAN RUNOFF PROGRAM
Lane Council of Governments, Eugene, Oregon

TESTING PROCEDURES, ACCURACIES and PRECISIONS
Lane County Environmental Health Water Laboratory
April 15, 1980

TEST	METHOD	Std. Method PRECISION Statement	Estimated Lab. PRECISION of Duplicates	Estimated ACCURACY vs. EPA Standards
Alkalinity	Methylorange	± 3-5%	Greatest of ± 1.5% or ± 1 mg/L	± 3%
Ammonia	Selecton electroide (Orion)	± 2% (manufacturer) ± 4-40% (EPA)	Greatest of ± 0.1 mg/L or ± 3%	Greatest of ± 4% or ± 0.1 mg/L
B.O.D.	Alkaline Azide	± 10-15% for sewage	± 1 mg for storm water	Not applicable
Chloride	Diphenylcarbazone	± 3.3%	Greatest of ± 1% or ± 0.5 mg/L	Greatest of ± 1.5% or ± 0.7 mg/L
Coliform Bacteria (fecal)	Membrane filter (m FC)		Greatest of ± 20% or ± 15/100 ml	NO WAY TO DETERMINE
C.O.D.	Dichromate/ H_2SO_4 Digestion	± 8%	Greatest of ± 1.5% or ± 0.5 mg/L	Greatest of ± 3% or ± 1 mg/L
Hardness	EDTA	± 2-3%	Greatest of ± 1% or ± 1 mg/L	± 3.5%
Herbicides	ditto SEE BELOW		2, 4-D- ± .1 mg/L 2, 4, 5, 7 ± .05 mg/L	± 0.1 µg/L ± 0.1 µg/L
Insecticides	EPA method for Organochlorine Pesticides & Chlorophenoxy Herbicides (Varian 1860 - electroncapture)		Toxaphene ± 5 µg/L Endrine ± 1.1 µg/L Lindane ± 0.05 µg/L Methoxychlor ± 0.1 µg/L	± 10% ditto ditto ditto

TEST	METHOD	Std. Method PRECISION Statement	Estimated Lab. PRECISION of Duplicates	Estimated ACCURACY vs. EPA Standards
METALS	IL-551 w/555 furnace	EPA SPECIFICATIONS	SENSITIVITY	
Pb			10 µg/L	± 10%
Fe (flame)			200 µg/L	ditto
Cu			10 µg/L	ditto
Cr			10 µg/L	ditto
Ni (flame)			300 µg/L	ditto
Zn (flame)			50 µg/L	ditto
As			10 µg/L	ditto
Hg			1 µg/L	ditto
Nitrate	Cadmium Reduction	± 6% @ 0.5 mg/L ± 1% @ 5.0 mg/L	± 1.5%	± 3%
Nitrite		SEE NITRATE		
pH	Meter (Electrovolt)	± 0.1 unit	± 0.1 unit	± 0.2 unit
Phosphate	Ammonium molybdate digestion	- 2 to ± 6% bias	Greatest of ± 2% or ± .002 mg/L	Greatest of ± 4% or ± .003 mg/L
Residue Total	Gravimetric	Greatest of ± 4 mg/L or ± 5%	Greatest of ± 2% or ± 1 mg/L	NO WAY TO DETERMINE
Residue-Non Filterable	Gravimetric	± 30% low range ± 8% high range	Greatest of ± 0.5 mg/L or ± 2%	NO WAY DETERMINE
Settleable Solids	Imhoff Cone	Not applicable	± 0.1 ml/L	NA
Sulfate	Barium precipitate	± 9%	Greatest of ± 3% or ± 0.2 mg/L	Greatest of ± 4% or ± 0.3 mg/L
Turbidity	Nephelometric (Hach)	Manufactures Specs. ± 2% full scale	Same	Same

TESTING PROCEDURES, ACCURACIES AND PRECISIONS
Chinook Research Laboratory, Inc.

TEST	METHOD	Std. Method PRECISION Statement	Estimated Lab. PRECISION of Duplicates	Estimated ACCURACY vs. EPA Standards
T.O.C.	Combustion infrared	5-10%	±0.5 mg/L	±3.0 mg/L
T.K.N.	Kjeldahl	50%	±0.05 mg/L	±0.1 mg/L
Oil & Grease	Partition-gravimetric	±0.9 mg	±0.12 mg	±2.0 mg/L

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                              208LCUG-0007     WQ0007          E-AMD-VEG-1
                                                              44 03 02.0 123 10 55.0  2
                                                              AMAZON CR VEG CONTROL STATION NR DANEBO RD
                                                              41039 OREGON                  LANE
/TYPA/AMBNT/STREAM/RUNOFF                                     PACIFIC NORTHWEST             130900
                                                              WILLAMETTE RIVFR
INDEX 1310001  001140  01520  0210                            10EPACOP  800531
MILES 0101.50 0145.90 017.30 013.40                            0000  CLASS 00 CSN-RSP 0551474-0042654
PARAMETER                               RMK  NUMBER   MEAN    VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00008   LAB      IDENT.     NUMBER                37  .000000   .000000   .000000   .000000   .000000 75/12/01 81/03/31
00010  WATER      TEMP       CENT                 30  14.5167   23.4050   4.83787   22.0000   5.00000 79/11/06 81/03/31
                                        J          7  12.2857   9.32149   3.05311   17.5000   9.00000 80/05/09 81/03/31
00061  STREAM     FLOW,    INST-CFS     TOT       37  14.0946   21.1924   4.60352   22.0000   5.00000 79/11/06 81/03/31
                                                  32  14.8937   518.606   22.7729   120.000   1.40000 79/11/06 81/03/31
                                        J          6  576.666    218347   467.276   1230.00   10.0000 75/12/01 81/01/06
00076   TURB     TRBIDMTR   HACH FTU    TOT       38  103.595   73036.8   270.253   1230.00   1.40000 75/12/01 81/03/31
00095 CNDUCTVY    AT 25C    MICROMHO              37  23.1216   1309.70   36.1898   150.000   1.20000 79/11/06 81/03/31
00300    DO                   MG/L                38  242.868   11336.4   106.473   399.000   59.0000 75/12/01 81/03/31
00315    BOD      7 DAY       MG/L                30  8.33866   6.06389   2.46250   15.2000   3.90000 80/01/07 81/03/31
00324    BOD      20 DAY      MG/L                 4  4.14000   .726400   .852291   5.30000   3.50000 80/01/07 80/03/10
                                                  21  12.0809   30.5717   5.52916   23.2000   .600000 80/05/06 81/03/31
                                        L          1  9.10000                       9.10000   9.10000 80/04/21 80/04/21
00335    COD     LOWLEVEL     MG/L      TOT       22  11.9454   29.5200   5.43323   23.2000   .600000 80/04/21 81/03/31
00400    PH                    SU                 37  22.5810   108.887   10.4349   49.6000   10.2000 79/11/06 81/03/31
00410   T ALK     CACO3       MG/L                38  7.18157   .157840   .397291   8.50000   6.60000 75/12/01 81/03/31
00500 RESIDUE     TOTAL       MG/L                37  68.6621   731.871   27.0531   119.000   18.3000 79/11/06 81/03/31
00530 RESIDUE    TOT NFLT     MG/L                38  195.816   2305.81   48.0189   345.000   101.000 75/12/01 81/03/31
00545 RESIDUE    SETTLBLE     ML/L                36  22.8666   2389.03   48.8777   234.000   1.00000 79/11/06 81/03/31
                                                   7  .184285   .027629   .166219   .450000   .000000 80/12/02 81/03/31
                                        K          9  .040000   .002025   .045000   .100000   .010000 79/12/03 81/03/31
00556 OIL-GRSE   FREON-GR     MG/L      TOT       16  .103125   .017596   .132651   .450000   .000000 79/12/03 81/03/31
                                                   8  7.23750   186.280   13.6484   41.0000   1.70000 80/03/10 80/12/02
                                        K          3  1.00000   .000000   .000000   1.00000   1.00000 80/05/09 80/09/02
00610 NH3+NH4-   N TOTAL      MG/L      TOT       11  5.53636   138.884   11.7849   41.0000   1.00000 80/03/10 80/12/02
                                                   1  .200000                       .200000   .200000 81/01/06 81/01/06
                                        J          1  .090000                       .090000   .090000 81/03/31 81/03/31
                                        K         34  .100000  .848E-07   .000291   .100000   .100000 79/11/06 81/03/31
00615  NO2-N      TOTAL       MG/L      TOT       36  .102500   .000282   .016799   .200000   .090000 79/11/06 81/03/31
                                                   5  .014000   .000030   .005477   .020000   .010000 80/11/04 81/03/31
                                        K         28  .100000  .728E-07   .000270   .100000   .100000 79/12/03 80/12/02
00625 TOT KJEL      N         MG/L      TOT       33  .086969   .000984   .031374   .100000   .010000 79/12/03 81/03/31
                                                   9  .133333   .012675   .112583   .340000   .020000 80/03/10 80/10/06
                                        K          9  .015556   .000028   .005270   .020000   .010000 80/06/12 81/01/06
00630 NO2&NO3    N-TOTAL      MG/L      TOT       18  .074444   .009650   .098233   .340000   .010000 80/03/10 81/01/06
                                                  18  .496111   .186448   .431797   1.40000   .080000 79/12/03 81/03/31
                                        J          1  .400000                       .400000   .400000 81/03/31 81/03/31
                                        K         16  .100000  .357E-07   .000189   .100000   .100000 80/03/10 80/10/06
00665 PHOS-TOT               MG/L P     TOT       35  .312285   .132547   .364071   1.40000   .080000 79/12/03 81/03/31
00680 T ORG C       C         MG/L                37  .120540   .007493   .086561   .403000   .044000 75/12/01 81/03/31
                                                  17  7.99411   21.5030   4.63714   17.8000   1.20000 80/03/10 81/01/06
```

1 duplicate

31

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                  208LCOG-0007     W00007          E-AMD-VEG-1
                                                                  44 03 02.0 123 10 55.0  2
                                                                  AMAZON CR VEG CONTROL STATION NR DANEBO RD
                                                                  41039 OREGON                     LANE
                                                                  PACIFIC NORTHWEST                130900
                                                                  WILLAMETTE RIVER
 /TYPA/AMBNT/STREAM/RUNOFF                                        10EPACOP  800531
  INDEX 1310001  001140  01520  0210                               0000  CLASS 00 CSN-RSP 0551474-0042654
  MILES 0101.50 0145.90 017.30 013.40
  PARAMETER                                RMK  NUMBER     MEAN  VARIANCE  STAN DEV   MAXIMUM   MINIMUM BEG DATE END DATE
  00900 TOT HARD    CACO3       MG/L                33  81.1666   971.822   31.1741   120.000   27.8000 79/12/03 81/03/31
  00940 CHLORIDE     TOTAL      MG/L                36  25.1124   252.040   15.8758   53.2000   3.60000 75/12/01 81/03/31
  00945 SULFATE    SO4-TOT      MG/L                16  8.66250   9.80249   3.13089   12.4000   2.80000 79/12/03 80/10/13
  00956  SILICA     TOTAL       MG/L                 1  40.0000                       40.0000   40.0000 75/12/01 75/12/01
  01002 ARSENIC     AS,TOT      UG/L                 1  5.00000                       5.00000   5.00000 80/08/19 80/08/19
                                           J         7  4.71428   1.90478   1.38014   6.00000   3.00000 80/02/11 80/12/02
                                           TOT       8  4.75000   1.64286   1.28174   6.00000   3.00000 80/02/11 80/12/02
  01034 CHROMIUM    CR,TOT      UG/L                 6  6.50000   42.7000   6.53452   18.0000   .000000 80/05/09 81/01/06
                                           J        27  1.03704   1.11396   1.05544   3.00000   .000000 79/11/06 81/03/31
                                           TOT      33  2.03030   12.1553   3.48645   18.0000   .000000 79/11/06 81/03/31
  01042 COPPER      CU,TOT      UG/L                11  9.45454   46.6727   6.83174   21.0000   1.00000 80/09/02 81/03/31
                                           J        22  3.68182   3.37014   1.83579   7.00000   1.00000 79/11/06 81/03/10
                                           TOT      33  5.60606   24.4337   4.94305   21.0000   1.00000 79/11/06 81/03/31
  01045   IRON      FE,TOT      UG/L                34  1384.56   1666136   1290.79   5140.00   150.000 79/11/06 81/03/31
  01051 LEAD        PB,TOT      UG/L                18  17.1111   216.811   14.7245   59.0000   2.00000 80/05/09 81/03/31
                                           J        16  4.12500   2.25000   1.50000   7.00000   2.00000 79/11/06 81/03/10
                                           TOT      34  11.0000   156.000   12.4900   59.0000   2.00000 79/11/06 81/03/31
  01067  NICKEL     NI,TOTAL    UG/L       J         1  140.000                       140.000   140.000 80/05/09 80/05/09
                                           K        24  100.000   .000000   .000000   100.000   100.000 79/11/06 80/10/13
                                           TOT      25  101.600   64.0026   8.00016   140.000   100.000 79/11/06 80/10/13
  01092 ZINC        ZN,TOT      UG/L                13  28.6154   410.091   20.2507   70.0000   3.00000 80/06/24 81/03/31
                                           J        21  10.4762   64.4619   8.02882   29.0000   .000000 79/11/06 80/10/06
                                           TOT      34  17.4118   268.250   16.3783   70.0000   .000000 79/11/06 81/03/31
  31616 FEC COLI    MFM-FCBR    /100ML              34  1195.29   3167007   1779.61   8800.00   20.0000 75/12/01 81/03/31
  39390 ENDRIN               TOT UG/L      K         3  .100000-.186E-08   .000000   .100000   .100000 80/05/09 80/07/08
  39400 TOXAPHEN              TOTUG/L      K         3  5.00000   .000000   .000000   5.00000   5.00000 80/05/09 80/07/08
  39480 MTHXYCLR    WHL SMPL    UG/L       K         3  .200000   .000000   .000000   .200000   .200000 80/05/09 80/07/08
  39530 MALATHN     WHL SMPL    UG/L       K         3  10.0000   .000000   .000000   10.0000   10.0000 80/05/09 80/07/08
  39570 DIAZINON    WHL SMPL    UG/L       K         3  2.00000   .000000   .000000   2.00000   2.00000 80/05/09 80/07/08
  39730  2,4-D      WHL SMPL    UG/L                 2  .280000   .028800   .169706   .400000   .160000 80/05/09 80/06/24
  39740 2,4,5-T     WHL SMPL    UG/L       K         2  .040000  .116E-08   .000034   .040000   .040000 80/05/09 80/06/24
  39760  SILVEX     WHL SMPL    UG/L       K         2  .040000  .116E-08   .000034   .040000   .040000 80/05/09 80/06/24
  39782 LINDANE     WHL SMPL    UG/L       K         3  .050000  .558E-08   .000075   .050000   .050000 80/05/09 80/07/08
  71900 MERCURY     HG,TOTAL    UG/L       K         7  .500000   .000000   .000000   .500000   .500000 79/11/06 80/12/02
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                   208LCOG-0008      WQ0008         E-AMD-VEG-2
                                                                  44 02 58.0 123 10 44.0  2
                                                                  AMAZON CR VEGETATION STATION 2 NR DANEBO RD
                                                                  41039 OREGON                 LANE
                                                                  PACIFIC NORTHWEST            130900
/TYPA/AMBNT/STREAM/RUNOFF                                         WILLAMETTE RIVER
                                                                  10EPACOP  800531
INDEX 1310001  001140  01520  0210                                 0000  CLASS 00 CSN-RSP 0551475-0042658
MILES 0101.50 0145.90 017.30 013.60
PARAMETER                                RMK   NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM   MINIMUM  BEG DATE END DATE
00008   LAB      IDENT.     NUMBER                 16  .000000  .000000  .000000  .000000  .000000 80/04/21 80/10/13
00010  WATER     TEMP        CENT                  14  17.1428  7.47836  2.73466  22.0000  13.0000 80/05/06 80/10/13
                                          J         2  14.5000  24.5000  4.94975  18.0000  11.0000 80/04/21 80/06/24
                                          TOT      16  16.8125  8.92917  2.98817  22.0000  11.0000 80/04/21 80/10/13
00061  STREAM    FLOW,      INST-CFS               16  7.36874  88.7129  9.41876  35.0000  1.40000 80/04/21 80/10/13
00076   TURB     TRBIDMTR   HACH FTU               16  7.19999  113.439  10.6508  45.0000  1.60000 80/04/21 80/10/13
00095 CNDUCTVY   AT 25C     MICROMHO               16  290.812  6964.73  83.4550  396.000  106.000 80/04/21 80/10/13
00300    DO                   MG/L                 13  6.48461  2.39805  1.54856  9.10000  4.10000 80/04/21 80/10/13
00324   BOD      20 DAY       MG/L                 10  8.64999  20.5806  4.53658  17.3000  3.70000 80/04/21 80/10/13
00335   COD      LOWLEVEL     MG/L                 16  22.7499  86.1752  9.28306  41.4000  11.8000 80/04/21 80/10/13
00400    PH                   SU                   16  7.06874  .098291  .313514  7.90000  6.70000 80/04/21 80/10/13
00410  T ALK     CACO3        MG/L                 16  81.2999  355.717  18.8604  105.000  38.2000 80/04/21 80/10/13
00500 RESIDUE    TOTAL        MG/L                 16  194.687  989.962  31.4637  238.000  100.000 80/04/21 80/10/13
00530 RESIDUE    TOT NFLT     MG/L                 16  6.38125  15.6590  3.95714  15.0000  1.00000 80/04/21 80/10/13
00545 RESIDUE    SETTLBLE     ML/L        K         2  .055000  .004050  .063640  .100000  .010000 80/07/22 80/09/23
00556 OIL-GRSE   FREON-GR     MG/L                  5  1.50000  .395001  .628491  2.60000  1.10000 80/06/24 80/09/23
                                          K         2  1.00000  .000000  .000000  1.00000  1.00000 80/05/09 80/06/24
                                          TOT       7  1.35714  .322857  .568205  2.60000  1.00000 80/05/09 80/09/23
00610 NH3+NH4-   N TOTAL      MG/L        K        16  .088750  .000945  .030741  .100000  .010000 80/04/21 80/10/13
00615  NO2-N     TOTAL        MG/L        K        14  .100000  .412E-07 .000203  .100000  .100000 80/04/21 80/09/23
00625 TOT KJEL   N            MG/L                  6  .486666  .642387  .801490  2.10000  .020000 80/05/09 80/09/23
                                          K         2  .020000-.232E-09  .000000  .020000  .020000 80/08/19 80/09/02
                                          TOT       8  .370000  .505514  .710995  2.10000  .020000 80/05/09 80/09/23
00630 NO2&NO3    N-TOTAL      MG/L                  5  .240000  .003000  .054772  .300000  .200000 80/04/21 80/10/13
                                          K        10  .100000  .000000  .000000  .100000  .100000 80/05/06 80/09/23
                                          TOT      15  .146667  .005524  .074322  .300000  .100000 80/04/21 80/10/13
00665 PHOS-TOT                MG/L P               16  .091500  .000899  .029983  .164000  .050000 80/04/21 80/10/13
00680 T ORG C    C            MG/L                  6  8.36667  15.5107  3.93836  15.0000  3.40000 80/05/09 80/09/23
                                          K         1  1.00000                     1.00000  1.00000 80/06/10 80/06/10
                                          TOT       7  7.31429  20.6781  4.54732  15.0000  1.00000 80/05/09 80/09/23
00900 TOT HARD   CACO3        MG/L                 15  95.3133  543.741  23.3182  126.000  44.0000 80/04/21 80/10/13
00940 CHLORIDE   TOTAL        MG/L                 16  31.6000  188.233  13.7198  54.4000  4.20000 80/04/21 80/10/13
00945 SULFATE    SO4-TOT      MG/L                 12  9.00833  5.36996  2.31732  12.1000  2.50000 80/04/21 80/10/13
01002 ARSENIC    AS,TOT       UG/L                  2  4.50000  .500000  .707107  5.00000  4.00000 80/08/19 80/09/02
01034 CHROMIUM   CR,TOT       UG/L                  2  8.50000  112.500  10.6066  16.0000  1.00000 80/05/09 80/09/02
                                          J        12  .500000  1.00000  1.00000  3.00000  .000000 80/04/21 80/10/13
                                          TOT      14  1.64286  17.9396  4.23551  16.0000  .000000 80/04/21 80/10/13
01042 COPPER     CU,TOT       UG/L                  3  3.00000  .000000  .000000  3.00000  3.00000 80/09/02 80/10/13
                                          J        11  4.00000  2.60000  1.61245  7.00000  2.00000 80/04/21 80/09/02
                                          TOT      14  3.78571  2.18132  1.47693  7.00000  2.00000 80/04/21 80/10/13
01045  IRON      FE,TOT       UG/L                 14  1017.86  1621202  1273.26  5220.00  210.000 80/04/21 80/10/13
```

No DUPLICATE

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                    20BLCOG-0008     W00008          E-AMD-VEG-2
                                                                   44 02 58.0 123 10 44.0  2
                                                                   AMAZON CR VEGETATION STATION 2 NR DANEBO RD
                                                                   41039 OREGON                   LANE
/TYPA/AMBNT/STREAM/RUNOFF                                          PACIFIC NORTHWEST              130900
                                                                   WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210                                 10EPACOP  800531
MILES 0101.50 0145.90 017.30 013.60                                 0000  CLASS 00 CSN-RSP 0551475-0042658
PARAMETER                                   *        *      *       *        *       *        *
01051 LEAD         PB,TOT       UG/L       RMK    NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM   MINIMUM   BEG DATE END DATE
                                                      7  9.85714  26.1429  5.11301  17.0000   3.00000 80/05/09 80/10/13
                                           J          7  4.00000  3.66667  1.91485  7.00000   2.00000 80/04/21 80/09/02
01067  NICKEL      NI,TOTAL     UG/L       TOT       14  6.92857  22.9945  4.79526  17.0000   2.00000 80/04/21 80/10/13
                                           J          1  130.000                    130.000   130.000 80/05/09 80/05/09
                                           K         13  100.000  .000000  .000000  100.000   100.000 80/04/21 80/10/13
01092 ZINC         ZN,TOT       UG/L       TOT       14  102.143  64.2884  8.01801  130.000   100.000 80/04/21 80/10/13
                                                      3  15.3333  44.3335  6.65834  23.0000   11.0000 80/06/24 80/10/13
                                           J         11  14.1818  107.364  10.3616  30.0000   3.00000 80/04/21 80/09/23
31616 FEC COLI     MFM-FCBR                TOT       14  14.4286  89.6484  9.46828  30.0000   3.00000 80/04/21 80/10/13
39390 ENDRIN                    /100ML               15  1306.00  1503868  1226.32  3800.00   90.0000 80/04/21 80/10/13
39400 TOXAPHEN                TOT UG/L     K          2  .100000-.372E-08  .000000  .100000   .100000 80/05/09 80/06/24
39480 MTHXYCLR     WHL SMPL    TOTUG/L     K          2  5.00000  .000000  .000000  5.00000   5.00000 80/05/09 80/06/24
39530 MALATHN      WHL SMPL     UG/L       K          2  .200000  .000000  .000000  .200000   .200000 80/05/09 80/06/24
39570 DIAZINON     WHL SMPL     UG/L       K          2  10.0000  .000000  .000000  10.0000   10.0000 80/05/09 80/06/24
39730  2,4-D       WHL SMPL     UG/L       K          2  2.00000  .000000  .000000  2.00000   2.00000 80/05/09 80/06/24
39740 2,4,5-T      WHL SMPL     UG/L                  2  .350000  .005000  .070710  .400000   .300000 80/05/09 80/06/24
39760  SILVEX      WHL SMPL     UG/L       K          2  .040000 .116E-08  .000034  .040000   .040000 80/05/09 80/06/24
39782 LINDANE      WHL SMPL     UG/L       K          2  .040000 .116E-08  .000034  .040000   .040000 80/05/09 80/06/24
                                           K          2  .050000 .372E-08  .000061  .050000   .050000 80/05/09 80/06/24
```

1 Duplicate

```
STORET RETRIEVAL DATE 82/01/18 - INVENT - VERSION OF SEP. 1981
                                                                208LCOG-0009    WQ0009       E-AMD-VEG-3
                                                                44 02 58.0 123 10 27.0  2
                                                                AMAZON CR VEGETATION STA 3 NEAR WILLOW CREEK
                                                                41039 OREGON                LANE
/TYPA/AMBNT/STREAM/RUNOFF                                       PACIFIC NORTHWEST           130900
                                                                WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210                              10EPACOP  800531
MILES 0101.50 0145.90 017.30 013.80                              0000  CLASS 00 CSN-RSP 0551476-0042660
PARAMETER
00008   LAB        IDENT.      NUMBER    RMK  NUMBER    MEAN    VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00010  WATER        TEMP        CENT             20   .000000   .000000  .000000   .000000   .000000 80/04/21 81/03/31
                                                 18   15.5556   9.64407  3.10549   21.0000   10.0000 80/04/21 81/03/31
                                          J       2   18.0000   2.00000  1.41421   19.0000   17.0000 80/06/12 80/06/24
00061  STREAM      FLOW,     INST-CFS     TOT    20   15.8000   9.30037  3.04965   21.0000   10.0000 80/04/21 81/03/31
00076   TURB     TRBIDMTR    HACH FTU            20   8.64999   109.077  10.4440   35.0000   1.40000 80/04/21 81/03/31
00095 CNDUCTVY    AT 25C     MICROMHO            20   9.75000   158.075  12.5728   45.0000   1.50000 80/04/21 81/03/31
00300    DO                    MG/L              20   274.750   8040.63  89.6696   396.000   106.000 80/04/21 81/03/31
00324   BOD       20 DAY       MG/L              19   6.38947   6.82321  2.61213   12.7000   3.00000 80/04/21 81/03/31
                                                 13   13.0308   54.3289  7.37082   26.4000   .600000 80/04/21 81/03/31
                                          L       2   9.25000   3.12500  1.76777   10.5000   8.00000 80/09/23 81/03/31
00335   COD      LOWLEVEL      MG/L       TOT    15   12.5267   48.5606  6.96855   26.4000   .600000 80/04/21 81/03/31
00400    PH                    SU                20   23.5800   66.0843  8.12922   40.5000   11.9000 80/04/21 81/03/31
00410  T ALK      CACO3        MG/L              20   7.03499   .086606  .294288   7.90000   6.70000 80/04/21 81/03/31
00500 RESIDUE     TOTAL        MG/L              20   78.3999   444.895  21.0925   107.000   38.2000 80/04/21 81/03/31
00530 RESIDUE    TOT NFLT      MG/L              20   194.500   1350.47  36.7488   255.000   98.0000 80/04/21 81/03/31
00545 RESIDUE    SETTLBLE      ML/L              19   6.73684   32.9825  5.74304   24.0000   .000000 80/04/21 81/03/31
                                                  3   .045000   .001425  .037749   .080000   .005000 80/06/24 81/03/31
                                          K       3   .010000   .000000  .000000   .010000   .010000 80/09/23 81/03/31
00556 OIL-GRSE   FREON-GR      MG/L       TOT     6   .027500   .000938  .030619   .080000   .005000 80/06/24 81/03/31
                                                  4   1.55000   .176667  .420318   2.10000   1.10000 80/05/28 80/09/23
                                          K       3   1.00000   .000000  .000000   1.00000   1.00000 80/05/09 80/08/19
00610 NH3+NH4-   N TOTAL       MG/L       TOT     7   1.31429   .174762  .418045   2.10000   1.00000 80/05/09 80/09/23
                                                  1   .120000                      .120000   .120000 81/03/31 81/03/31
                                          K      18   .095000   .000450  .021214   .100000   .010000 80/04/21 81/03/31
00615  NO2-N      TOTAL        MG/L       TOT    19   .096315   .000458  .021400   .120000   .010000 80/04/21 81/03/31
                                                  2   .015000   .000050  .007071   .020000   .010000 81/03/31 81/03/31
                                          K      16   .100000  .357E-07  .000189   .100000   .100000 80/04/21 80/09/23
00625 TOT KJEL      N          MG/L       TOT    18   .090555   .000759  .027542   .100000   .010000 80/04/21 81/03/31
                                                  4   .585000   .440633  .663802   1.30000   .020000 80/05/09 80/06/24
                                          K       6   .020000  .512E-09  .000023   .020000   .020000 80/06/12 80/09/23
00630 NO2&NO3    N-TOTAL       MG/L       TOT    10   .246000   .232004  .481668   1.30000   .020000 80/05/09 80/09/23
                                                  9   .182222   .003870  .062206   .300000   .100000 80/04/21 81/03/31
                                          K      10   .100000   .000000  .000000   .100000   .100000 80/05/06 80/09/23
00665 PHOS-TOT                 MG/L P     TOT    19   .138947   .003499  .059151   .300000   .100000 80/04/21 81/03/31
00680 T ORG C       C          MG/L              19   .101421   .001253  .035399   .210000   .050000 80/04/21 81/03/31
00900 TOT HARD    CACO3        MG/L               9   7.69999   19.8225  4.45225   16.0000   1.40000 80/05/09 80/09/23
00940 CHLORIDE    TOTAL        MG/L              19   91.1737   652.236  25.5389   121.000   42.0000 80/04/21 81/03/31
00945 SULFATE    SO4-TOT       MG/L              19   30.0052   232.081  15.2342   56.6000   4.80000 80/04/21 81/03/31
01002 ARSENIC    AS,TOT        UG/L              13   8.71538   4.56976  2.13770   11.9000   3.50000 80/04/21 80/10/13
01034 CHROMIUM   CR,TOT        UG/L               3   5.33333   1.33334  1.15470   6.00000   4.00000 80/08/19 80/09/02
                                                  1   11.0000                      11.0000   11.0000 80/05/09 80/05/09
```

178

33

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                    208LCOG-0009    W00009       E-AMD-VEG-3
                                                                    44 02 58.0 123 10 27.0  2
                                                                    AMAZON CR VEGETATION STA 3 NEAR WILLOW CREEK
                                                                    41039 OREGON              LANE
/TYPA/AMBNT/STREAM/RUNOFF                                           PACIFIC NORTHWEST         130900
                                                                    WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210                                  10EPACOP  800531
MILES 0101.50 0145.90 017.30 013.80                                  0000  CLASS 00 CSN-RSP 0551476-0042660
PARAMETER                                 RMK   NUMBER    MEAN   VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
01034 CHROMIUM   CR,TOT       UG/L         J        17  .882353   2.61029  1.61564  6.00000   .000000 80/04/21 81/03/31
01042 COPPER     CU,TOT       UG/L        TOT       18  1.44444   8.14379  2.85373  11.0000   .000000 80/04/21 81/03/31
                                                     6  6.66667   39.8667  6.31401  17.0000   2.00000 80/09/02 81/03/31
                                           J        12  4.00000   3.09091  1.75810  8.00000   2.00000 80/04/21 80/09/02
01045   IRON     FE,TOT       UG/L        TOT       18  4.88889   15.3987  3.92412  17.0000   2.00000 80/04/21 81/03/31
01051 LEAD       PB,TOT       UG/L                  18  1093.33   1343399  1159.05  5250.00   190.000 80/04/21 81/03/31
                                                    13  12.0385   70.1026  8.37273  30.0000   4.00000 80/05/09 81/03/31
                                           J         5  4.20000   2.70002  1.64317  6.00000   3.00000 80/04/21 80/09/02
01067  NICKEL    NI,TOTAL     UG/L        TOT       18  9.86111   63.1708  7.94800  30.0000   3.00000 80/04/21 81/03/31
                                           J         1  160.000                     160.000   160.000 80/05/09 80/05/09
                                           K        15  100.000   .000000  .000000  100.000   100.000 80/04/21 80/10/13
01092 ZINC       ZN,TOT       UG/L        TOT       16  103.750   225.000  15.0000  160.000   100.000 80/04/21 80/10/13
                                                     9  18.0000   159.750  12.6392  44.0000   4.00000 80/06/24 81/03/31
                                           J         9  13.5556   150.528  12.2690  32.0000   .000000 80/04/21 80/09/02
31616 FEC COLI   MFM-FCBR     /100ML      TOT       18  15.7778   151.242  12.2981  44.0000   .000000 80/04/21 81/03/31
                                                    18  1413.89   1929860  1389.19  4800.00   60.0000 80/05/06 81/03/31
                                           L         1  1000.00                     1000.00   1000.00 80/04/21 80/04/21
39390 ENDRIN                  TOT UG/L    TOT       19  1392.11   1831662  1353.39  4800.00   60.0000 80/04/21 81/03/31
39400 TOXAPHEN                 TOTUG/L     K         5  .100000-.279E-08   .000000  .100000   .100000 80/04/21 80/09/02
39480 MTHXYCLR   WHL SMPL      UG/L        K         5  5.00000   .000000  .000000  5.00000   5.00000 80/04/21 80/09/02
39530 MALATHN    WHL SMPL      UG/L        K         5  .200000-.149E-07   .000000  .200000   .200000 80/04/21 80/09/02
39570 DIAZINON   WHL SMPL      UG/L        K         5  10.0000   .000000  .000000  10.0000   10.0000 80/04/21 80/09/02
39730  2,4-D     WHL SMPL      UG/L        K         5  2.00000   .000000  .000000  2.00000   2.00000 80/04/21 80/09/02
                                                     2  2.10000   5.78000  2.40416  3.80000   .400000 80/05/09 80/07/22
                                           K         1  .100000                     .100000   .100000 80/05/09 80/05/09
39740 2,4,5-T    WHL SMPL      UG/L       TOT        3  1.43333   4.22333  2.05507  3.80000   .100000 80/05/09 80/07/22
39760  SILVEX    WHL SMPL      UG/L        K         3  .040000  .372E-08  .000061  .040000   .040000 80/05/09 80/07/22
39782 LINDANE    WHL SMPL      UG/L        K         3  .040000  .372E-08  .000061  .040000   .040000 80/05/09 80/07/22
                                           K         5  .050000  .372E-08  .000061  .050000   .050000 80/04/21 80/09/02
```

No Duplicate

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                     208LCOG-0010     WQ0010        E-AMD-OP      FLOW0010
                                                                    44 02 48.0 123 08 01.0  2
                                                                    AMAZON CHANNEL AT OAK PATCH ROAD
                                                                    41039 OREGON                  LANE
                                                                    PACIFIC NORTHWEST             130900
/TYPA/AMBNT/STREAM/RUNOFF                                           WILLAMETTE RIVER
                                                                    10EPACOP  800531
INDEX 1310001  001140  01520  0210                                   0000  CLASS 00 CSN-RSP 0551477-0042663
MILES 0101.50 0145.90 017.30 015.60
PARAMETER                                  RMK   NUMBER     MEAN  VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00008    LAB       IDENT.      NUMBER                87  .000000   .000000  .000000  .000000   .000000 75/12/16 80/12/02
00010  WATER        TEMP        CENT                 25  13.8520   25.4938  5.04914  25.0000   6.00000 76/02/14 81/01/06
00061  STREAM       FLOW,     INST-CFS               69  101.130   32477.8  180.216  1200.00   1.50000 76/01/07 81/01/06
                                            J        18  76.5555   47065.9  216.947  900.000   1.00000 75/12/16 80/12/02
                                            TOT      87  96.0459   35084.1  187.307  1200.00   1.00000 75/12/16 81/01/06
00076    TURB      TRBIDMTR   HACH FTU               23  25.7913   1343.31  36.6512  120.000   1.70000 79/11/06 81/01/06
00095 CNDUCTVY      AT 25C    MICROMHO               84  145.238   4623.59  67.9970  347.000   56.0000 75/12/16 81/01/06
.00300    DO                    MG/L                 15  8.96399   10.6531  3.26391  14.1000   2.22000 78/07/12 81/01/06
00315    BOD        7 DAY       MG/L                 36  5.30166   21.2652  4.61142  22.0000   .820000 76/01/07 80/03/10
00324    BOD       20 DAY       MG/L                  8  19.7750   127.082  11.2731  39.0000   6.00000 80/05/06 81/01/06
                                            L         1  20.7000                     20.7000   20.7000 80/05/09 80/05/09
                                            TOT       9  19.8778   111.292  10.5495  39.0000   6.00000 80/05/06 81/01/06
00335    COD       LOWLEVEL     MG/L                 71  35.4478   524.758  22.9076  129.000   6.00000 80/05/06 81/01/06
00400     PH                     SU                  77  7.12462   .176967  .420674  8.70000   5.10000 75/12/16 81/01/06
00410  T ALK        CACO3       MG/L                 23  68.6521   727.821  26.9781  115.000   6.50000 75/12/16 81/01/06
00500 RESIDUE       TOTAL       MG/L                 71  189.282   6832.03  82.6561  633.000   20.2000 79/11/06 81/01/06
00530 RESIDUE      TOT NFLT     MG/L                 71  63.7830   8664.35  93.0825  574.000   89.0000 75/12/16 81/01/06
                                            K         1  1.00000                     1.00000   1.00000 76/01/04 81/01/06
                                            TOT      72  62.9111   8597.07  92.7204  574.000   1.00000 78/07/12 78/07/12
00545 RESIDUE      SETTLBLE     ML/L                 12  8.04333   635.400  25.2071  88.0000   1.00000 76/01/04 81/01/06
                                            K         4  .055000   .002700  .051961  .100000   .010000 76/11/17 80/12/02
                                            TOT      16  6.04624   478.724  21.8798  88.0000   .010000 79/12/03 81/01/06
00556 OIL-GRSE     FREON-GR     MG/L                  7  10.7286   511.439  22.6150  62.0000   .010000 76/11/17 81/01/06
                                            K         1  1.00000                     1.00000   1.40000 80/03/10 80/12/02
                                            TOT       8  9.51249   450.207  21.2181  62.0000   1.00000 80/09/02 80/09/02
00610 NH3+NH4-     N TOTAL      MG/L        K        23  .100000 .650E-07  .000255  .100000   1.00000 80/03/10 80/12/02
00615  NO2-N        TOTAL       MG/L                  1  .020000                     .020000   .100000 79/11/06 81/01/06
                                            K        21  .100000 .625E-07  .000250  .100000   .020000 81/01/06 81/01/06
                                            TOT      22  .096363   .000291  .017058  .100000   .100000 79/12/03 80/12/02
00625 TOT KJEL        N         MG/L                  2  .125000   .008450  .091924  .190000   .020000 79/12/03 81/01/06
                                            K         3  .016667   .000033  .005773  .020000   .060000 80/03/10 80/10/06
                                            TOT       5  .060000   .005650  .075167  .190000   .010000 80/09/02 80/12/02
00630 NO2&NO3      N-TOTAL      MG/L                 45  .368444   .133573  .365476  1.90000   .010000 80/03/10 80/12/02
                                            K         6  .100000-.223E-08   .000000  .100000   .010000 76/07/19 81/01/06
                                            TOT      51  .336862   .125174  .353800  1.90000   .100000 78/07/31 80/07/08
00665 PHOS-TOT                 MG/L P                69  .221014   .022225  .149080  .867000   .010000 76/07/19 81/01/06
00680 T ORG C         C         MG/L                  5  14.0000   20.5801  4.53653  20.0000   .045000 75/12/16 81/01/06
00900 TOT HARD      CACO3       MG/L                 24  67.1374   379.761  19.4875  95.1000   8.40000 80/03/10 80/12/02
00940 CHLORIDE      TOTAL       MG/L                 37  7.86349   75.5897  8.69424  44.6000   30.1000 75/12/16 81/01/06
00945 SULFATE      SO4-TOT      MG/L                 12  7.27499   4.85296  2.20294  10.1000   1.30000 75/12/16 81/01/06
00956  SILICA       TOTAL       MG/L                 46  41.2804   2162.40  46.5016  218.000   3.20000 79/12/03 80/07/08
                                                                                           1.80000 75/12/16 78/10/02
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                     208LCOG-0010     WQ0010        E-AMD-OP     FLOW0010
                                                                     44 02 48.0 123 08 01.0  2
                                                                     AMAZON CHANNEL AT OAK PATCH ROAD
                                                                     41039 OREGON              LANE
                                                                     PACIFIC NORTHWEST         130900
/TYPA/AMBNT/STREAM/RUNOFF                                            WILLAMETTE RIVER
                                                                     10EPACOP  800531
INDEX 1310001  001140  01520  0210                                    0000  CLASS 00 CSN-RSP 0551477-0042663
MILES 0101.50 0145.90 017.30 015.60
PARAMETER                               RMK  NUMBER    MEAN   VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00956  SILICA      TOTAL      MG/L      L          1  150.000                      150.000   150.000 76/01/07 76/01/07
                                        TOT       47  43.5936   2366.88   48.6506  218.000   1.80000 75/12/16 78/10/02
01002 ARSENIC      AS,TOT     UG/L                 3  13.3333   86.3335   9.29158  24.0000   7.00000 80/09/02 80/09/02
                                        J          6  4.33333   1.86668   1.36627  6.00000   3.00000 80/02/11 80/12/02
                                        TOT        9  7.33333   43.0000   6.55744  24.0000   3.00000 80/02/11 80/12/02
01034 CHROMIUM     CR,TOT     UG/L                 6  7.83333   14.1667   3.76387  11.0000   2.00000 80/05/09 81/01/06
                                        J         13  1.53846   1.60257   1.26593  4.00000   .000000 79/11/06 80/10/06
                                        TOT       19  3.52632   14.0409   3.74712  11.0000   .000000 79/11/06 81/01/06
01042 COPPER       CU,TOT     UG/L                11  12.7273   74.4182   8.62660  27.0000   1.00000 80/05/09 81/01/06
                                        J          8  4.75000   8.50000   2.91548  10.0000   1.00000 79/11/06 80/07/08
                                        K          1  200.000                      200.000   200.000 76/08/13 76/08/13
                                        TOT       20  18.9000   1874.83   43.2993  200.000   1.00000 76/08/13 81/01/06
01045   IRON       FE,TOT     UG/L                31  2320.26   2304864   1518.18  4600.00   230.000 75/12/16 81/01/06
                                        L          1  4050.00                      4050.00   4050.00 76/01/07 76/01/07
                                        TOT       32  2374.31   2324009   1524.47  4600.00   230.000 75/12/16 81/01/06
01051 LEAD         PB,TOT     UG/L                14  30.7857   803.875   28.3527  99.0000   5.00000 79/11/06 81/01/06
                                        J          5  3.80000   4.70002   2.16795  7.00000   2.00000 79/12/03 80/07/08
                                        TOT       19  23.6842   730.673   27.0310  99.0000   2.00000 79/11/06 81/01/06
01067  NICKEL      NI,TOTAL   UG/L      K         14  100.000   .000000   .000000  100.000   100.000 79/11/06 80/10/06
01092 ZINC         ZN,TOT     UG/L                11  42.5454   622.074   24.9414  90.0000   13.0000 79/11/06 81/01/06
                                        J          8  18.7500   141.643   11.9014  40.0000   5.00000 79/12/03 80/10/06
                                        TOT       19  32.5263   546.375   23.3747  90.0000   5.00000 79/11/06 81/01/06
31616 FEC COLI     MFM-FCBR   /100ML              67  2360.49   8816252   2969.22  14700.0   8.00000 75/12/16 81/01/06
                                        K          2  60.0000   3200.00   56.5685  100.000   20.0000 76/09/27 76/10/24
                                        TOT       69  2293.81   8708137   2950.96  14700.0   8.00000 75/12/16 81/01/06
39730   2,4-D      WHL SMPL   UG/L                 1  .190000                      .190000   .190000 80/06/24 80/06/24
                                        K          1  .100000                      .100000   .100000 80/12/02 80/12/02
                                        TOT        2  .145000   .004050   .063640  .190000   .100000 80/06/24 80/12/02
39740 2,4,5-T      WHL SMPL   UG/L      K          2  .040000  .116E-08   .000034  .040000   .040000 80/06/24 80/12/02
39760  SILVEX      WHL SMPL   UG/L      K          2  .040000  .116E-08   .000034  .040000   .040000 80/06/24 80/12/02
71900 MERCURY      HG,TOTAL   UG/L      J          1  .700000                      .700000   .700000 80/12/02 80/12/02
                                        K          6  .500000   .000000   .000000  .500000   .500000 79/11/06 80/12/02
                                        TOT        7  .528571   .005714   .075594  .700000   .500000 79/11/06 80/12/02
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                          208LCOG-0011    WQ0011
                                                          44 02 40.0 123 05 53.0  2        E-AMD-WA      FLOW0011
                                                          AMAZON CHANNEL AT WASHINGTON STREET
                                                          41039 OREGON                LANE
/TYPA/AMBNT/STREAM/RUNOFF                                 PACIFIC NORTHWEST           130900
                                                          WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210                        10EPACOP  800531
MILES 0101.50 0145.90 017.30 017.50                        0000  CLASS 00 CSN-RSP 0551478-0042669
PARAMETER                                   RMK  NUMBER     MEAN   VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00008   LAB       IDENT.       NUMBER             20    .000000    .000000  .000000   .000000   .000000 76/02/25 80/10/06
00010  WATER       TEMP         CENT              13    13.8077    36.5641  6.04683   27.0000   5.00000 78/07/31 81/01/06
                                            J      1    14.0000                       14.0000   14.0000 80/11/04 80/11/04
                                            TOT   14    13.8214    33.7541  5.80983   27.0000   5.00000 78/07/31 81/01/06
00061  STREAM      FLOW,      INST-CFS            10    5.40000    4.26668  2.06559   10.0000   3.00000 80/01/07 81/01/06
                                            J     12    10.0833    137.720  11.7354   40.0000   1.00000 76/02/25 79/12/03
                                            TOT   22    7.95454    79.6645  8.92550   40.0000   1.00000 76/02/25 81/01/06
00076   TURB      TRBIDMTR     HACH FTU           12    15.8083    516.277  22.7217   80.0000   1.50000 79/10/30 81/01/06
00095 CNDUCTVY     AT 25C      MICROMHO           22    210.455    4636.20  68.0897   310.000   92.0000 76/02/25 81/01/06
00300    DO                      MG/L             13    13.7692    16.1840  4.02293   22.8000   9.20000 78/07/12 81/01/06
00315   BOD        7 DAY         MG/L              8    4.28250    8.08247  2.84297   10.4000   1.40000 78/04/18 80/03/10
00324   BOD        20 DAY        MG/L              7    10.2286    51.8390  7.19993   23.6000   1.20000 80/05/06 81/01/06
00335   COD       LOWLEVEL       MG/L             21    12.5857    91.4640  9.56368   46.0000   1.50000 76/02/25 81/01/06
00400    PH                       SU              20    8.05999    .708869  .841943   9.60000   6.50000 76/02/25 81/01/06
00410  T ALK       CACO3         MG/L             12    87.5083    721.551  26.8617   118.000   44.7000 79/10/30 81/01/06
00500 RESIDUE      TOTAL         MG/L             19    175.842 32[illegible].70  57.4169   356.000   75.0000 76/02/25 81/01/06
00530 RESIDUE     TOT NFLT       MG/L             21    25.0571    6083.20  77.9949   352.000   .000000 76/02/25 81/01/06
00545 RESIDUE     SETTLBLE       ML/L              1    .020000                       .020000   .020000 80/10/06 80/10/06
                                            K      5    .046000    .002430  .049295   .100000   .010000 79/12/03 81/01/06
                                            TOT    6    .041667    .002057  .045350   .100000   .010000 79/12/03 81/01/06
00556 OIL-GRSE    FREON-GR       MG/L              1    40.0000                       40.0000   40.0000 80/03/10 80/03/10
00610 NH3+NH4-    N TOTAL        MG/L             12    .100000   .108E-07  .000104   .100000   .100000 79/10/30 81/01/06
00615  NO2-N       TOTAL         MG/L       K      2    .015000    .000050  .007071   .020000   .010000 80/11/04 81/01/06
                                            K      9    .111111    .001111  .033333   .200000   .100000 79/12/03 80/10/06
                                            TOT   11    .093636    .002405  .049046   .200000   .010000 79/12/03 81/01/06
00625 TOT KJEL       N           MG/L              2    .095000    .000050  .007071   .100000   .090000 80/03/10 80/06/10
                                            K      1    .010000                       .010000   .010000 80/11/04 80/11/04
                                            TOT    3    .066667    .002433  .049329   .100000   .010000 80/03/10 80/11/04
00630 NO2&NO3    N-TOTAL         MG/L             12    .240833    .049299  .222034   .800000   .020000 76/07/19 81/01/06
                                            K      7    .100000    .000000  .000000   .100000   .100000 78/07/31 80/10/06
                                            TOT   19    .188947    .034999  .187079   .800000   .020000 76/07/19 81/01/06
00665 PHOS-TOT                  MG/L P            20    .110500    .006809  .082514   .400000   .047000 76/02/25 81/01/06
00680 T ORG C        C           MG/L              2    11.5500    4.80518  2.19207   13.1000   10.0000 80/03/10 80/11/04
                                            K      1    1.00000                       1.00000   1.00000 80/06/10 80/06/10
                                            TOT    3    8.03333    39.5034  6.28517   13.1000   1.00000 80/03/10 80/11/04
00900 TOT HARD     CACO3         MG/L             12    80.9333    509.000  22.5610   111.000   39.0000 76/02/25 81/01/06
00940 CHLORIDE     TOTAL         MG/L             14    9.03928    26.2416  5.12266   19.5000   3.20000 76/02/25 81/01/06
00945 SULFATE     SO4-TOT        MG/L              5    7.82000    21.4670  4.63325   14.7000   2.40000 79/10/30 80/07/08
00956  SILICA      TOTAL         MG/L              6    17.6667    766.742  27.6901   72.0000   2.30000 76/02/25 78/10/02
01002 ARSENIC     AS,TOT         UG/L              3    3.00000    4.00000  2.00000   5.00000   1.00000 80/02/11 80/08/04
01034 CHROMIUM    CR,TOT         UG/L       J      1    1.00000                       1.00000   1.00000 81/01/06 81/01/06
```

No Duplicate

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                          208LCOG-0011    WQ0011         E-AMD-WA      FLOW0011
                                                          44 02 40.0 123 05 53.0  2
                                                          AMAZON CHANNEL AT WASHINGTON STREET
                                                          41039 OREGON                LANE
/TYPA/AMBNT/STREAM/RUNOFF                                 PACIFIC NORTHWEST           130900
                                                          WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210                        10EPACOP  800531
MILES 0101.50 0145.90 017.30 017.50                        0000  CLASS 00 CSN-RSP 0551478-0042669
PARAMETER
                                             RMK  NUMBER   MEAN    VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
01034 CHROMIUM    CR,TOT        UG/L         J       10  1.40000  3.15556   1.77639   5.00000   .000000 79/10/30 80/10/06
01042 COPPER      CU,TOT        UG/L         TOT     11  1.36364  2.85455   1.68954   5.00000   .000000 79/10/30 81/01/06
                                                      3  7.33333  57.3334   7.57188   16.0000   2.00000 79/12/03 81/01/06
                                             J        8  3.37500  3.69643   1.92261   6.00000   1.00000 79/10/30 80/08/04
01045   IRON      FE,TOT        UG/L         TOT     11  4.45454  17.4727   4.18004   16.0000   1.00000 79/10/30 81/01/06
01051 LEAD        PB,TOT        UG/L                 13  1899.54  9215782   3035.75   10850.0   60.0000 76/02/25 81/01/06
                                                      6  6.83333  30.5667   5.52872   17.0000   3.00000 79/10/30 81/01/06
                                             J        6  3.00000  2.00000   1.41421   5.00000   1.00000 79/12/03 80/07/08
01067  NICKEL     NI,TOTAL      UG/L         TOT     12  4.91667  18.8106   4.33712   17.0000   1.00000 79/10/30 81/01/06
01092 ZINC        ZN,TOT        UG/L         K       10  100.000  .000000   .000000   100.000   100.000 79/10/30 80/10/06
                                                      4  16.2500  222.917   14.9304   35.0000   .000000 79/10/30 81/01/06
                                             J        7  7.28571  25.2381   5.02375   15.0000   3.00000 80/01/07 80/10/06
31616 FEC COLI    MFM-FCBR      /100ML       TOT     11  10.5455  102.473   10.1229   35.0000   .000000 79/10/30 81/01/06
                                                     18  808.055  1976908   1406.03   6000.00   10.0000 76/02/25 81/01/06
                                             K        1  20.0000                      20.0000   20.0000 80/02/11 80/02/11
                                             L        1  3000.00                      3000.00   3000.00 80/07/08 80/07/08
39730  2,4-D      WHL SMPL      UG/L         TOT     20  878.250  2049186   1431.50   6000.00   10.0000 76/02/25 81/01/06
39740 2,4,5-T     WHL SMPL      UG/L                  1  .200000                      .200000   .200000 80/08/04 80/08/04
39760  SILVEX     WHL SMPL      UG/L         K        1  .040000                      .040000   .040000 80/08/04 80/08/04
71900 MERCURY     HG,TOTAL      UG/L         J        1  .020000                      .020000   .020000 80/08/04 80/08/04
                                             K        3  .500000  .000000   .000000   .500000   .500000 79/10/30 80/10/06
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                         208LCOG-0012    WQ0012         E-AMD-29      FLOW0012
                                                         44 01 36.0 123 04 55.0  2
                                                         AMAZON CHANNEL AT 29TH STREET - EUGENE
                                                         41039 OREGON                LANE
                                                         PACIFIC NORTHWEST           130900
                                                         WILLAMETTE RIVER
/TYPA/AMBNT/STREAM/RUNOFF                                10EPACOP  800531
INDEX 1310001  001140  01520  0210                        0000  CLASS 00 CSN-RSP 0551479-0042671
MILES 0101.50 0145.90 017.30 019.60
PARAMETER                               RMK  NUMBER    MEAN    VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00008   LAB       IDENT.     NUMBER             25   .000000   .000000  .000000  .000000   .000000  75/12/16 81/05/13
00010  WATER       TEMP       CENT              22   11.4545   15.0693  3.88192  21.5000   5.00000  78/07/31 81/05/13
                                          J      2   9.50000   .500000  .707107  10.0000   9.00000  81/03/15 81/03/15
                                          TOT   24   11.2917   14.0853  3.75304  21.5000   5.00000  78/07/31 81/05/13
00061  STREAM      FLOW,     INST-CFS           21   5.91905   63.0336  7.93937  25.0000   .300000  78/07/31 81/05/13
                                          J      9   7.62222   74.1620  8.61174  25.0000   .300000  75/12/16 81/03/15
                                          TOT   30   6.43000   64.5601  8.03493  25.0000   .300000  75/12/16 81/05/13
00076   TURB      TRBIDMTR   HACH FTU           25   29.0560   431.453  20.7714  65.0000   2.70000  79/10/30 81/05/13
00095 CNDUCTVY     AT 25C    MICROMHO           30   305.067    111314  333.638  1560.00   46.0000  75/12/16 81/05/13
00300    DO                    MG/L             20   9.64999   3.21441  1.79288  12.5000   6.60000  78/07/12 81/03/31
00315    BOD       7 DAY       MG/L              6   2.30333   .801666  .895358  3.40000   1.00000  78/07/12 80/03/10
00324    BOD       20 DAY      MG/L             17   12.9235   56.6443  7.52624  28.1000   2.60000  80/05/06 81/03/31
00335    COD      LOWLEVEL     MG/L             28   18.4571   213.727  14.6194  82.5000   5.80000  75/12/16 81/03/31
00400    PH                     SU              15   7.46666   .059501  .243927  7.90000   7.20000  75/12/16 81/03/10
00410  T ALK       CACO3       MG/L             13   98.9307   1123.23  33.5146  140.000   46.4000  79/10/30 81/05/13
00500 RESIDUE      TOTAL       MG/L             28   177.250   1136.34  33.7097  234.000   110.000  75/12/16 81/03/31
00530 RESIDUE     TOT NFLT     MG/L             22   19.7909   762.410  27.6118  105.000   2.00000  78/07/31 81/03/31
                                          K      1   1.00000                     1.00000   1.00000  78/07/12 78/07/12
                                          TOT   23   18.9739   743.107  27.2600  105.000   1.00000  78/07/12 81/03/31
00545 RESIDUE     SETTLBLE     ML/L              5   .350000   .057500  .239792  .700000   .150000  80/10/25 81/03/31
                                          J      4   .002500   .000025  .005000  .010000   .000000  81/03/15 81/03/31
                                          K      8   .021250   .001012  .031820  .100000   .010000  79/12/03 81/03/31
                                          TOT   17   .113529   .039637  .199090  .700000   .000000  79/12/03 81/03/31
00556 OIL-GRSE    FREON-GR     MG/L              3   21.8000   653.921  25.5719  51.0000   3.40000  80/03/10 80/10/06
00610 NH3+NH4-    N TOTAL      MG/L       K     13   .100000 .298E-07  .000173  .100000   .100000  79/10/30 81/03/10
00615  NO2-N       TOTAL       MG/L              5   .018000   .000020  .004472  .020000   .010000  81/03/31 81/03/31
                                          J      1   .010000                     .010000   .010000  81/01/06 81/01/06
                                          K      9   .100000   .000000  .000000  .100000   .100000  79/12/03 80/10/06
                                          TOT   15   .066667   .001795  .042370  .100000   .010000  79/12/03 81/03/31
00625 TOT KJEL       N         MG/L             12   .815000   .499990  .707100  2.10000   .040000  80/03/10 81/03/31
                                          K      2   .010000-.145E-10  .000000  .010000   .010000  80/11/04 81/01/06
                                          TOT   14   .700000   .508523  .713108  2.10000   .010000  80/03/10 81/03/31
00630 NO2&NO3     N-TOTAL      MG/L             27   .265185   .053987  .232352  1.20000   .070000  78/07/12 81/03/31
00665 PHOS-TOT                MG/L P            28   .120321   .004403  .066354  .320000   .038000  75/12/16 81/03/31
00680 T ORG C        C         MG/L             14   13.6643   63.3486  7.95918  26.0000   2.10000  80/03/10 81/03/31
00900 TOT HARD     CACO3       MG/L             15   81.3799   990.433  31.4711  135.000   42.8000  75/12/16 81/03/15
00940 CHLORIDE     TOTAL       MG/L             16   6.68749   9.72285  3.11815  12.2000   2.40000  75/12/16 81/03/15
00945 SULFATE     SO4-TOT      MG/L              6   6.40000   21.4360  4.62990  13.9000   2.00000  79/10/30 80/10/13
00956  SILICA      TOTAL       MG/L              4   14.1000   229.907  15.1627  36.0000   2.00000  75/12/16 78/10/02
01002 ARSENIC     AS,TOT       UG/L       J      2   2.00000   .000000  .000000  2.00000   2.00000  80/02/11 80/08/04
01034 CHROMIUM    CR,TOT       UG/L              1   1.00000                     1.00000   1.00000  81/03/15 81/03/15
```

2 Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                           208LCOG-0012     WQ0012              E-AMD-29      FLOW0012
                                                           44 01 36.0 123 04 55.0  2
                                                           AMAZON CHANNEL AT 29TH STREET - EUGENE
                                                           41039 OREGON                      LANE
 /TYPA/AMBNT/STREAM/RUNOFF                                 PACIFIC NORTHWEST                 130900
                                                           WILLAMETTE RIVER
 INDEX 1310001   001140  01520  0210                       10EPACOP  000531
 MILES 0101.50 0145.90 017.30 019.60                        0000  CLASS 00 CSN-RSP 0551479-0042671
 PARAMETER                                 PMK  NUMBER    MEAN   VARIANCE STAN DEV  MAXIMUM   MINIMUM  REG DATE END DATE
 01034 CHROMIUM   CR,TOT      UG/L         J        13  1.69231  2.06411  1.43670  5.00000   .000000 79/10/30 81/03/15
 01042 COPPER     CU,TOT      UG/L         TOT      14  1.64286  1.93956  1.39268  5.00000   .000000 79/10/30 81/03/15
                                                     6  8.66667  12.2667  3.50239  14.0000   4.00000 79/12/03 81/03/15
                                           J         8  3.62500  2.26786  1.50594  6.00000   1.00000 79/10/30 81/03/10
 01045   IRON     FE,TOT      UG/L         TOT      14  5.78571  12.6429  3.55568  14.0000   1.00000 79/10/30 81/03/15
 01051 LEAD       PB,TOT      UG/L                  24  1824.71  3093697  1758.89  7700.00   250.000 75/12/16 81/05/13
                                                    14  18.4286  227.187  15.0727  50.0000   4.00000 79/10/30 81/05/13
                                           J         9  3.33333  2.50001  1.58114  6.00000   2.00000 79/12/03 81/03/10
 01067  NICKEL    NI,TOTAL    UG/L         TOT      23  12.5217  191.897  13.8527  50.0000   2.00000 79/10/30 81/05/13
                                           J         1  140.000                    140.000   140.000 80/05/06 80/05/06
                                           K         9  100.000  .000000  .000000  100.000   100.000 79/10/30 80/10/06
 01092 ZINC       ZN,TOT      UG/L         TOT      10  104.000  160.000  12.6491  140.000   100.000 79/10/30 80/10/06
                                                    10  42.7000  559.568  23.6552  97.0000   14.0000 79/10/30 81/03/31
                                           J        12  10.3333  25.3334  5.03322  18.0000   3.00000 79/12/03 81/05/13
 31616 FEC COLI   MFM-FCBR    /100ML       TOT      22  25.0454  525.189  22.9170  97.0000   3.00000 79/10/30 81/05/13
 71900 MERCURY    HG,TOTAL    UG/L                  21  787.143   784531  885.738  3210.00   100.000 75/12/16 81/03/31
                                           K         3  .500000  .000000  .000000  .500000   .500000 79/10/30 80/10/06
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                              208LCOG-0029       WQ0029          E-AMD-29ST
                                                              44 01 41.0 123 04 55.0  2
                                                              AMAZON CHANNEL ABV 29TH ST SEDIMENT TRAP
                                                              41039 OREGON                     LANE
/TYPA/AMBNT/STREAM/RUNOFF                                     PACIFIC NORTHWEST                130900
                                                              WILLAMETTE RIVER
INDEX 1309001  001140  01520  0210                            10EPACOP  810228
MILES 0101.50 0145.90 017.30 019.70                            0000  CLASS 00 CSN-RSP 0582219-0042706
PARAMETER
00008   LAB      IDENT.      NUMBER     RMK   NUMBER    MEAN    VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00010  WATER      TEMP        CENT                 8  .000000   .000000   .000000   .000000   .000000 81/03/10 81/05/13
                                                   9  10.8333   7.81253   2.79509   16.5000   8.00000 80/10/13 81/05/13
                                         J         2  9.50000   .500000   .707107   10.0000   9.00000 81/03/15 81/03/15
00061  STREAM    FLOW,      INST-CFS     TOT      11  10.5909   6.59094   2.56728   16.5000   8.00000 80/10/13 81/05/13
                                                  11  6.80000   72.1680   8.49517   25.0000   .300000 80/10/13 81/05/13
                                         J         3  11.3333   36.3335   6.02773   17.0000   5.00000 81/03/15 81/03/15
00076   TURB     TRBIDMTR   HACH FTU     TOT      14  7.77143   64.8299   8.05170   25.0000   .300000 80/10/13 81/05/13
00095 CNDUCTVY    AT 25C    MICROMHO              13  30.4923   346.779   18.6220   60.0000   7.20000 80/10/13 81/05/13
00300     DO                  MG/L                14  392.500    229690   479.260   1560.00   46.0000 80/10/13 81/05/13
00324    BOD      20 DAY      MG/L                 5  9.75999   2.75311   1.65925   12.6000   8.30000 81/03/10 81/03/31
00335    COD     LOWLEVEL     MG/L                10  12.9100   61.6854   7.85401   22.0000   1.60000 80/10/25 81/03/31
00400     PH                   SU                 13  21.5923   87.5892   9.35891   41.1000   8.10000 80/10/13 81/03/31
00410   T ALK      CACO3      MG/L                 1  7.80000                       7.80000   7.80000 81/03/10 81/03/10
00500 RESIDUE      TOTAL      MG/L                 2  105.800   816.082   28.5671   126.000   85.6000 81/03/10 81/05/13
00530 RESIDUE    TOT NFLT     MG/L                13  152.923   1048.25   32.3767   211.000   110.000 80/10/13 81/03/31
00545 RESIDUE    SETTLBLE     ML/L                10  28.3000   1100.01   33.1664   116.000   2.00000 80/11/04 81/03/31
                                                   3  .400000   .062500   .250000   .650000   .150000 80/10/26 81/03/31
                                         J         5  .006000   .000030   .005477   .010000   .000000 81/03/10 81/03/31
                                         K         4  .010000-.776E-10    .000000   .010000   .010000 80/10/25 81/01/21
00610 NH3+NH4-   N TOTAL      MG/L       TOT      12  .105833   .042845   .206990   .650000   .000000 80/10/25 81/03/31
00615  NO2-N      TOTAL       MG/L       K         2  .100000-.372E-08    .000000   .100000   .100000 80/11/04 81/03/10
00625 TOT KJEL      N         MG/L                 3  .020000-.232E-09    .000000   .020000   .020000 81/03/31 81/03/31
                                                   6  .816666   .281707   .530760   1.60000   .040000 80/11/04 81/03/31
                                         K         2  .010000-.145E-10    .000000   .010000   .010000 81/01/06 81/01/21
00630 NO2&NO3    N-TOTAL      MG/L       TOT       8  .615000   .340657   .583658   1.60000   .010000 80/11/04 81/03/31
00665 PHOS-TOT              MG/L P                13  .210769   .023991   .154891   .710000   .090000 80/10/13 81/03/31
00680 T ORG C       C         MG/L                13  .122538   .003671   .060593   .281000   .057000 80/10/13 81/03/31
00900 TOT HARD    CACO3       MG/L                 8  16.1625   56.2916   7.50277   31.0000   8.60000 80/11/04 81/03/31
00940 CHLORIDE    TOTAL       MG/L                 6  67.2499   769.737   27.7441   118.000   42.1000 80/10/13 81/03/15
00945 SULFATE    SO4-TOT      MG/L                 5  4.67999   6.48708   2.54697   8.90000   2.60000 80/11/04 81/03/15
01034 CHROMIUM   CR,TOT       UG/L                 1  9.90000                       9.90000   9.90000 80/10/13 80/10/13
01042 COPPER     CU,TOT       UG/L       J         4  2.00000   .000000   .000000   2.00000   2.00000 81/03/10 81/03/15
                                                   3  11.3333   2.33350   1.52758   13.0000   10.0000 81/03/15 81/03/15
                                         J         1  7.00000                       7.00000   7.00000 81/03/10 81/03/10
01045   IRON     FE,TOT       UG/L       TOT       4  10.2500   6.25000   2.50000   13.0000   7.00000 81/03/10 81/03/15
01051 LEAD       PB,TOT       UG/L                11  1311.82    497997   705.689   2600.00   400.000 80/11/04 81/05/13
01092 ZINC       ZN,TOT       UG/L                10  21.1000   245.434   15.6663   56.0000   6.00000 80/11/04 81/05/13
                                                   8  47.7500   668.500   25.8554   95.0000   25.0000 81/01/21 81/05/13
                                         J         1  14.0000                       14.0000   14.0000 81/03/31 81/03/31
31616 FEC COLI   MFM-FCBR    /100ML      TOT       9  44.0000   711.500   26.6739   95.0000   14.0000 81/01/21 81/05/13
                                                   9  998.009   1360526   1166.42   3410.00   2.08000 80/11/04 81/03/31
```

No Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                             208LCOG-0013    WQ0013         E-AC-A2GG    FLOW0013
                                                            44 05 38.0 123 10 39.0  2
                                                            A-2 DRAINAGE CHANNEL AT GOLDEN GARDENS
                                                            41039 OREGON                    LANE
/CANAL/TYPA/AMBNT/RUNOFF                                    PACIFIC NORTHWEST               130900
                                                            WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210   0150                   10EPACOP  800531
MILES 0101.50 0145.90 017.30 008.60 002.60                   0000  CLASS 00 CSN-RSP 0551480-0042673
PARAMETER
00008 LAB        IDENT.     NUMBER     RMK NUMBER      MEAN  VARIANCE  STAN DEV   MAXIMUM   MINIMUM BEG DATE END DATE
00010 WATER      TEMP       CENT               14   .000000   .000000   .000000   .000000   .000000 78/04/25 80/10/06
00061 STREAM     FLOW,      INST-CFS           11   13.5455   17.3228   4.16206   22.0000   8.00000 78/07/31 81/01/06
                                                8   8.11250   212.424   14.5748   43.0000   .300000 79/12/03 81/01/06
                                       J        7   1.41428   2.29476   1.51485   4.00000   .300000 78/04/25 80/05/06
00076 TURB       TRBIDMTR   HACH FTU   TOT     15   4.98666   119.160   10.9160   43.0000   .300000 78/04/25 81/01/06
00095 CNDUCTVY   AT 25C     MICROMHO           10   7.43000   114.269   10.6897   36.0000   2.00000 79/11/06 81/01/06
00300 DO                    MG/L               14   210.857   659.678   25.6842   245.000   165.000 78/04/25 81/01/06
00315 BOD        7 DAY      MG/L               10   8.97600   9.25903   3.04287   16.2000   5.20000 78/07/12 81/01/06
00324 BOD        20 DAY     MG/L                8   3.38000   1.18835   1.09012   5.50000   2.00000 78/04/25 80/05/06
00335 COD        LOWLEVEL   MG/L                3   14.8000   12.2701   3.50288   17.9000   11.0000 80/07/08 81/01/06
00400 PH                    SU                 14   14.8500   56.3135   7.50423   27.5000   6.20000 78/04/25 81/01/06
00410 T ALK      CACO3      MG/L               14   7.04285   .156475   .395570   7.80000   6.50000 78/04/25 81/01/06
00500 RESIDUE    TOTAL      MG/L               10   79.2999   190.831   13.8141   91.0000   50.1000 79/11/06 81/01/06
00530 RESIDUE    TOT NFLT   MG/L               12   163.417   165.182   12.8523   177.000   137.000 78/07/31 81/01/06
00545 RESIDUE    SETTLBLE   ML/L               12   5.81667   60.5124   7.77897   29.0000   1.00000 78/04/25 81/01/06
                                                1   .400000                       .400000   .400000 80/07/08 80/07/08
                                       K        4   .032500   .002025   .045000   .100000   .010000 79/12/03 81/01/06
00556 OIL-GRSE   FREON-GR   MG/L       TOT      5   .106000   .028530   .168908   .400000   .010000 79/12/03 81/01/06
                                                1   1.40000                       1.40000   1.40000 80/10/06 80/10/06
                                       K        1   1.00000                       1.00000   1.00000 80/03/10 80/03/10
00610 NH3+NH4-   N TOTAL    MG/L       TOT      2   1.20000   .080000   .282843   1.40000   1.00000 80/03/10 80/10/06
                                                1   .600000                       .600000   .600000 79/12/03 79/12/03
                                       K        9   .100000   .000000   .000000   .100000   .100000 79/11/06 81/01/06
00615 NO2-N      TOTAL      MG/L       TOT     10   .150000   .025000   .158114   .600000   .100000 79/11/06 81/01/06
                                                1   .010000                       .010000   .010000 81/01/06 81/01/06
                                       K        8   .100000   .000000   .000000   .100000   .100000 79/12/03 80/10/06
00625 TOT KJEL   N          MG/L       TOT      9   .090000   .000900   .030000   .100000   .010000 79/12/03 81/01/06
00630 NO2&NO3    N-TOTAL    MG/L                2   .130000-.372E-08    .000000   .130000   .130000 80/03/10 80/10/06
                                               12   1.81916   1.56732   1.25193   3.60000   .100000 78/04/25 81/01/06
                                       K        1   .100000                       .100000   .100000 78/07/31 78/07/31
00665 PHOS-TOT              MG/L P     TOT     13   1.68692   1.66406   1.28999   3.60000   .100000 78/04/25 81/01/06
00680 T ORG C    C          MG/L               11   .474454   .114416   .338255   1.35000   .091000 78/07/12 81/01/06
00900 TOT HARD   CACO3      MG/L                2   23.3000   228.981   15.1321   34.0000   12.6000 80/03/10 80/10/06
00940 CHLORIDE   TOTAL      MG/L                6   87.5666   246.283   15.6934   102.400   61.6000 79/12/03 81/01/06
00945 SULFATE    SO4-TOT    MG/L                8   5.51250   .895562   .946341   6.90000   4.60000 79/12/03 81/01/06
00956 SILICA     TOTAL      MG/L                5   9.00000   5.50006   2.34522   11.2000   5.40000 79/12/03 80/07/08
01002 ARSENIC    AS,TOT     UG/L                3   3.26667   .223335   .472584   3.80000   2.90000 78/07/12 78/10/02
01034 CHROMIUM   CR,TOT     UG/L                2   55.5000   4.50000   2.12132   57.0000   54.0000 80/03/10 80/03/10
                                                3   10.3333   81.3335   9.01851   19.0000   1.00000 79/12/03 81/01/06
                                       J        6   1.83333   1.36667   1.16905   3.00000   .000000 80/03/10 80/10/06
                                       TOT      9   4.66667   39.2500   6.26498   19.0000   .000000 79/12/03 81/01/06
```

2 Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                             208LCOG-0013    WQ0013          E-AC-A2GG    FLOW0013
                                                             44 05 38.0 123 10 39.0  2
                                                             A-2 DRAINAGE CHANNFL AT GOLDEN GARDENS
                                                             41039 OREGON               LANE
/CANAL/TYPA/AMBNT/RUNOFF                                     PACIFIC NORTHWEST          130900
                                                             WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210   0150                    10EPACOP  800531
MILES 0101.50 0145.90 017.30 008.60 002.60                    0000  CLASS 00 CSN-RSP 0551480-0042673
PARAMETER
01042 COPPER      CU,TOT       UG/L        RMK   NUMBER    MEAN    VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
                                                    3   5.33333   44.3333   6.65833   13.0000   1.00000 79/12/03 81/01/06
                                            J       6   5.00000   15.6000   3.94968   10.0000   1.00000 80/01/07 80/07/08
01045   IRON      FE,TOT       UG/L        TOT      9   5.11111   20.8611   4.56740   13.0000   1.00000 79/12/03 81/01/06
01051 LEAD        PB,TOT       UG/L                 9   932.000    681057   825.262   2700.00   120.000 79/12/03 81/01/06
                                                    2   2.00000   .000000   .000000   2.00000   2.00000 80/10/06 81/01/06
                                            J       7   2.57143   6.95239   2.63674   7.00000   .000000 79/12/03 80/07/08
01067  NICKEL     NI,TOTAL     UG/L        TOT      9   2.44444   5.27779   2.29734   7.00000   .000000 79/12/03 81/01/06
01092 ZINC        ZN,TOT       UG/L        K        8   100.000   .000000   .000000   100.000   100.000 79/12/03 80/10/06
                                                    3   41.0000   903.000   30.0500   70.0000   10.0000 79/12/03 81/01/06
                                            J       6   13.5000   165.900   12.8802   30.0000   3.00000 80/03/10 80/10/06
31616 FEC COLI    MFM-FCBR     /100ML      TOT      9   22.6667   518.501   22.7706   70.0000   3.00000 79/12/03 81/01/06
                                                   10   242.000    184729   429.801   1440.00   20.0000 78/04/25 80/10/06
                                            K       3   13.3333   33.3335   5.77352   20.0000   10.0000 80/03/10 81/01/06
39390 ENDRIN                              TOT      13   189.231    148608   385.497   1440.00   10.0000 78/04/25 81/01/06
39400 TOXAPHEN                 TOT UG/L    K        1   .100000                       .100000   .100000 80/03/11 80/03/11
39480 MTHXYCLR                 TOTUG/L     K        1   5.00000                       5.00000   5.00000 80/03/11 80/03/11
39530 MALATHN     WHL SMPL     UG/L        K        1   .200000                       .200000   .200000 80/03/11 80/03/11
39570 DIAZINON    WHL SMPL     UG/L        K        1   10.0000                       10.0000   10.0000 80/03/11 80/03/11
39782 LINDANE     WHL SMPL     UG/L        K        1   2.00000                       2.00000   2.00000 80/03/11 80/03/11
71900 MERCURY     HG,TOTAL     UG/L        K        1   .050000                       .050000   .050000 80/03/11 80/03/11
                                            K       2   .500000   .000000   .000000   .500000   .500000 79/12/03 80/10/06
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                          208LCUG-0014    WQ0014          E-AC-A3BER   FLOW0014
                                                         44 03 21.0 123 09 43.0  2
                                                         A-3 DRAINAGE CHANNEL AT BERTELSEN ROAD
                                                         41039 OREGON                   LANE
/CANAL/TYPA/AMBNT/RUNOFF                                 PACIFIC NORTHWEST              130900
                                                         WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210   0210                10EPACOP  800531
MILES 0101.50 0145.90 017.30 012.20 002.40                0000  CLASS 00 CSN-RSP 0551481-0042675
PARAMETER
00008   LAB                                RMK  NUMBER     MEAN   VARIANCE STAN DEV  MAXIMUM   MINIMUM  REG DATE END DATE
00010  WATER       IDENT.     NUMBER               53  .000000   .000000  .000000  .000000  .000000 76/02/14 81/03/31
00061  STREAM       TEMP       CENT                32  14.7812   18.0635  4.25012  23.5000  7.00000 78/07/31 81/03/31
                    FLOW,     INST-CFS             10  9.21000   324.643  18.0178  60.0000  1.20000 78/10/02 81/03/31
                                            J      48  10.4646   350.457  18.7205  85.0000  .200000 76/02/14 80/12/02
00076   TURB      TRBIDMTR   HACH FTU      TOT     58  10.2483   340.461  18.4516  85.0000  .200000 76/02/14 81/03/31
00095 CNDUCTVY     AT 25C    MICROMHO              32  18.7375   738.770  27.1803  100.000  3.10000 79/11/06 81/03/31
00300    DO                    MG/L                56  222.804   3393.31  58.2521  324.000  60.0000 76/02/14 81/03/31
00315   BOD        7 DAY       MG/L                28  5.84285   2.96994  1.72335  9.00000  2.90000 78/07/12 81/03/31
                                                   13  6.66153   28.1342  5.30417  23.0000  2.70000 76/08/10 80/03/10
                                            L       4  5.97499   1.29591  1.13838  7.00000  4.80000 76/02/14 76/09/14
00324   BOD        20 DAY      MG/L        TOT     17  6.49999   21.4338  4.62966  23.0000  2.70000 76/02/14 80/03/10
                                                   16  16.5500   23.5844  4.85637  24.1000  6.60000 80/05/06 81/03/10
                                            L       4  13.2500   42.9700  6.55515  19.5000  7.10000 80/05/09 81/03/31
00335   COD       LOWLEVEL     MG/L        TOT     20  15.8900   27.2385  5.21905  24.1000  6.60000 80/05/06 81/03/31
00400    PH                     SU                 56  42.9678   510.768  22.6002  148.000  17.2000 76/02/14 81/03/31
00410  T ALK       CACO3       MG/L                57  7.00522   .056737  .238194  7.60000  6.60000 76/02/14 81/03/31
00500 RESIDUE      TOTAL       MG/L                32  99.3062   1144.27  33.8271  140.000  18.9000 79/11/06 81/03/31
00530 RESIDUE     TOT NFLT     MG/L                55  193.964   1052.54  32.4428  357.000  121.000 76/02/14 81/03/31
00545 RESIDUE     SETTLBLE     ML/L                54  29.0518   1764.43  42.0051  251.000  2.00000 76/02/14 81/03/31
                                                   10  .363499   .640200  .800125  2.60000  .010000 76/09/14 80/12/02
                                           J        5  .012000   .000470  .021679  .050000  .000000 81/03/10 81/03/31
                                           K        7  .048571   .002314  .048107  .100000  .010000 77/02/20 81/01/06
00546 RESIDUE     SETTLBLE     MG/L        TOT     22  .183409   .303622  .551019  2.60000  .000000 76/09/14 81/03/31
00556 OIL-GRSE    FREON-GR     MG/L        K        1  .100000                      .100000  .100000 80/10/06 80/10/06
                                                    8  5.38750   42.4640  6.51644  20.0000  1.00000 80/06/24 80/12/02
                                           K        4  1.00000   .000000  .000000  1.00000  1.00000 80/03/10 80/12/02
00610 NH3+NH4-    N TOTAL      MG/L        TOT     12  3.92500   31.6893  5.62932  20.0000  1.00000 80/03/10 80/12/02
                                                    8  1.07500   2.40785  1.55173  4.50000  .100000 79/11/06 81/03/31
                                           K       24  .100000  .621E-07  .000249  .100000  .100000 79/12/03 81/03/10
00615  NO2-N       TOTAL       MG/L        TOT     32  .343750   .727700  .853054  4.50000  .100000 79/11/06 81/03/31
                                                    4  .042500   .000692  .026300  .080000  .020000 81/01/06 81/03/31
                                           K       24  .100000  .621E-07  .000249  .100000  .100000 79/12/03 80/12/02
00625 TOT KJEL       N         MG/L        TOT     28  .091785   .000497  .022288  .100000  .020000 79/12/03 81/03/31
                                                    6  .075000   .001870  .043244  .150000  .030000 80/03/10 80/10/06
                                           K       10  .016000   .000027  .005164  .020000  .010000 80/06/10 81/01/06
00630 NO2&NO3     N-TOTAL      MG/L        TOT     16  .038125   .001510  .038853  .150000  .010000 80/03/10 81/01/06
                                                   27  .587407   .355003  .595821  2.10000  .010000 76/08/10 81/03/31
                                           J        2  .115000   .000050  .007071  .120000  .110000 76/07/19 77/02/21
                                           K       17  .094706   .000477  .021829  .100000  .010000 76/09/27 80/10/06
00665 PHOS-TOT                MG/L P       TOT     46  .384782   .264940  .514724  2.10000  .010000 76/07/19 81/03/31
                                                   53  .338753   .020157  .141976  .726000  .080000 76/02/14 81/03/31
```

4 Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                          208LCOG-0014     WQ0014          E-AC-A3BER   FLOW0014
                                                          44 03 21.0 123 09 43.0  2
                                                          A-3 DRAINAGE CHANNEL AT BERTELSEN ROAD
                                                          41039 OREGON                  LANE
/CANAL/TYPA/AMBNT/RUNOFF                                  PACIFIC NORTHWEST             130900
                                                          WILLAMETTE RIVER
INDEX 1310001  001140  01520  0210   0210                 10EPACUP  800531
MILES 0101.50 0145.90 017.30 012.20 002.40                 0000  CLASS 00 CSN-RSP 0551481-0042675
PARAMETER                          RMK  NUMBER      MEAN   VARIANCE  STAN DEV   MAXIMUM   MINIMUM  BEG DATE END DATE
00680 T ORG C  C         MG/L              16   14.2812    74.2376   8.61612   41.0000   5.70000 80/03/10 81/01/06
00900 TOT HARD CACO3     MG/L              29   87.2172    963.993   31.0482   123.100   22.9000 76/02/25 81/03/31
00940 CHLORIDE TOTAL     MG/L              33   5.93939    7.35007   2.71110   14.0000   1.60000 76/02/14 81/03/31
00945 SULFATE  SO4-TOT   MG/L              10   2.99000    1.95658   1.39878   4.80000   1.00000 79/12/03 80/07/08
                                   K        1   1.00000                        1.00000   1.00000 80/06/24 80/06/24
                                   TOT     11   2.80909    2.12093   1.45634   4.80000   1.00000 79/12/03 80/07/08
00956 SILICA   TOTAL     MG/L              16   30.9187    2751.16   52.4515   206.000   4.40000 76/02/25 78/10/02
01002 ARSENIC  AS,TOT    UG/L               4   20.0000    210.000   14.4914   33.0000   6.00000 80/03/10 80/12/02
                                   J        2   5.50000    .500000   .707107   6.00000   5.00000 80/02/11 80/08/04
                                   TOT      6   15.1667    182.167   13.4969   33.0000   5.00000 80/02/11 80/12/02
01034 CHROMIUM CR,TOT    UG/L               7   3.14286    5.47620   2.34013   7.00000   1.00000 80/09/02 81/03/10
                                   J       22   1.09091    1.41991   1.19160   4.00000   .000000 79/11/06 81/03/31
                                   TOT     29   1.58621    3.03695   1.74268   7.00000   .000000 79/11/06 81/03/31
01042 COPPER   CU,TOT    UG/L              12   13.3667    123.395   11.1083   30.0000   1.00000 80/05/09 81/03/31
                                   J       17   2.88235    4.48530   2.11785   8.00000   .000000 79/11/06 81/03/10
                                   TOT     29   7.22069    78.6553   8.86878   30.0000   .000000 79/11/06 81/03/31
01045 IRON     FE,TOT    UG/L              31   2284.16    1137648   1066.61   5100.00   1100.00 76/02/25 81/03/31
01051 LEAD     PB,TOT    UG/L              15   16.8666    245.982   15.6838   53.0000   2.00000 79/12/03 81/03/31
                                   J       15   2.93333    4.92382   2.21897   9.00000   .000000 79/11/06 81/03/10
                                   TOT     30   9.90000    171.334   13.0895   53.0000   .000000 79/11/06 81/03/31
01067 NICKEL   NI,TOTAL  UG/L      J        2   240.000    7200.00   84.8528   300.000   180.000 80/05/09 80/10/06
                                   K       18   100.000    .000000   .000000   100.000   100.000 79/11/06 80/10/06
                                   TOT     20   114.000    2235.79   47.2841   300.000   100.000 79/11/06 80/10/06
01092 ZINC     ZN,TOT    UG/L              20   123.800    6394.38   79.9649   292.000   17.0000 79/12/03 81/03/31
                                   J       10   10.7000    99.5667   9.97831   30.0000   2.00000 79/11/06 80/10/06
                                   TOT     30   86.1000    7160.92   84.6222   292.000   2.00000 79/11/06 81/03/31
31616 FEC COLI MFM-FCBR  /100ML            45   1279.51    9329483   3054.42   17400.0   10.0000 76/02/14 81/03/31
                                   K        3   20.0000    .000000   .000000   20.0000   20.0000 80/02/11 80/10/06
                                   TOT     48   1200.79    8828906   2971.35   17400.0   10.0000 76/02/14 81/03/31
39390 ENDRIN             TOT UG/L  K        8   .100000    .000000   .000000   .100000   .100000 80/06/10 81/01/06
39400 TOXAPHEN           TOTUG/L   K        7   5.00000    .000000   .000000   5.00000   5.00000 80/06/10 81/01/06
39480 MTHXYCLR WHL SMPL  UG/L      K        8   .200000    .000000   .000000   .200000   .200000 80/06/10 81/01/06
39530 MALATHN  WHL SMPL  UG/L      K        8   10.0000    .000000   .000000   10.0000   10.0000 80/06/10 81/01/06
39570 DIAZINON WHL SMPL  UG/L      K        8   2.00000    .000000   .000000   2.00000   2.00000 80/06/10 81/01/06
39730  2,4-D   WHL SMPL  UG/L      K        2   .100000-.372E-08     .000000   .100000   .100000 80/06/24 80/12/02
39740 2,4,5-T  WHL SMPL  UG/L      K        2   .040000   .116E-08   .000034   .040000   .040000 80/06/24 80/12/02
39760  SILVEX  WHL SMPL  UG/L      K        2   .040000   .116E-08   .000034   .040000   .040000 80/06/24 80/12/02
39782 LINDANE  WHL SMPL  UG/L      K        8   .050000   .266E-08   .000052   .050000   .050000 80/06/10 81/01/06
71900 MERCURY  HG,TOTAL  UG/L               3   1.06667    .013333   .115470   1.20000   1.00000 80/12/02 80/12/02
                                   K        5   .500000    .000000   .000000   .500000   .500000 79/11/06 80/12/02
                                   TOT      8   .712500    .089821   .299702   1.20000   .500000 79/11/06 80/12/02
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                   208LCOG-0015    W00015          E-AC-A3WAL   FLOW0015
                                                                  44 03 14.0 123 09 13.0  2
                                                                  A-3 DRAINAGE CHANNEL AT WALLIS ROAD
                                                                  41039 OREGON                 LANE
 /CANAL/TYPA/AMBNT/RUNOFF                                         PACIFIC NORTHWEST            130900
                                                                  WILLAMETTE RIVER
 INDEX 1310001  001140  01520  0210   0210                        10EPACUP  800531
 MILES 0101.50 0145.90 017.30 012.20 003.00                        0000  CLASS 00 CSN-RSP 0551482-0042679
 PARAMETER                                                                                                          2 - Duplicates
 00008   LAB      IDENT.     NUMBER    RMK  NUMBER    MEAN    VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
 00010  WATER      TEMP       CENT             27  .000000   .000000  .000000  .000000   .000000 78/07/12 81/03/31
 00061  STREAM     FLOW,    INST-CFS           29  14.7414   22.2791  4.72008  25.5000   8.00000 78/07/31 81/03/31
                                            J   5  .840000   .518000  .719722  1.70000   .100000 80/02/11 81/01/06
 00076   TURB    TRBIDMTR   HACH FTU      TOT  27  10.4222   323.466  17.9851  60.0000   .200000 78/07/12 81/03/31
 00095 CNDUCTVY   AT 25C    MICROMHO           32  8.92500   283.856  16.8480  60.0000   .100000 78/07/12 81/03/31
 00300    DO                  MG/L             29  27.2345   1367.04  36.9735  135.000   3.00000 79/11/06 81/03/31
 00315    BOD     7 DAY       MG/L             32  223.406   6257.29  79.1030  336.000   58.0000 78/07/12 81/03/31
 00324    BOD     20 DAY      MG/L             22  5.48999   12.9597  3.59996  12.0000   .400000 78/07/12 81/03/31
                                                5  5.04000   3.08303  1.75586  6.50000   2.20000 78/07/12 80/03/10
                                            L  11  22.1636   105.403  10.2666  41.3000   .000000 80/05/09 81/01/06
 00335    COD    LOWLEVEL     MG/L        TOT   3  16.8666   292.304  17.0969  36.6000   6.50000 80/05/09 81/03/31
 00400    PH                   SU              14  21.0286   131.136  11.4515  41.3000   .000000 80/05/09 81/03/31
 00410  T ALK     CACO3       MG/L             32  51.3874   2501.34  50.0134  280.000   17.4000 78/07/12 81/03/31
 00500 RESIDUE    TOTAL       MG/L             31  7.04193   .097160  .311705  7.90000   6.60000 78/07/12 81/03/31
 00530 RESIDUE   TOT NFLT     MG/L             29  97.6758   1530.93  39.1271  146.000   18.6000 79/11/06 81/03/31
 00545 RESIDUE   SETTLBLE     ML/L             31  199.065   1007.10  31.7348  292.000   136.000 78/07/31 81/03/31
                                               29  30.2138   1749.87  41.8314  168.000   2.00000 78/07/12 81/03/31
                                               11  .122272   .058017  .240867  .800000   .005000 80/06/24 81/01/06
                                            J   3  .020000   .000700  .026458  .050000   .000000 81/03/31 81/03/31
                                            K   6  .025000   .001350  .036742  .100000   .010000 79/12/03 81/01/06
 00556 OIL-GRSE  FREON-GR     MG/L        TOT  20  .077750   .033517  .183077  .800000   .000000 79/12/03 81/03/31
                                                5  3.26000   5.96303  2.44193  7.50000   1.50000 80/08/04 80/12/02
                                            K   5  1.00000   .000000  .000000  1.00000   1.00000 80/03/10 80/09/02
 00610 NH3+NH4-   N TOTAL     MG/L        TOT  10  2.13000   4.06901  2.01718  7.50000   1.00000 80/03/10 80/12/02
                                                6  .350000   .223000  .472228  1.30000   .100000 80/07/08 81/03/31
                                            K  23  .100000  .650E-07  .000255  .100000   .100000 79/11/06 81/03/31
 00615  NO2-N     TOTAL       MG/L        TOT  29  .151724   .050443  .224596  1.30000   .100000 79/11/06 81/03/31
                                                6  .031667   .000377  .019408  .060000   .010000 80/11/04 81/03/31
                                            K  22  .100000  .624E-07  .000250  .100000   .100000 79/12/03 80/12/02
 00625 TOT KJEL     N         MG/L        TOT  28  .085357   .000885  .029751  .100000   .010000 79/12/03 81/03/31
                                                7  13.5071   1259.83  35.4941  94.0000   .020000 80/03/10 80/12/02
                                            K   5  .016000   .000030  .005477  .020000   .010000 80/06/24 80/12/02
 00630 NO2&NO3   N-TOTAL      MG/L        TOT  12  7.88583   735.440  27.1190  94.0000   .010000 80/03/10 80/12/02
                                               21  .681904   .392625  .626598  2.00000   .040000 78/07/12 81/03/31
                                            K  10  .100000   .000000  .000000  .100000   .100000 78/07/31 80/10/06
 00665 PHOS-TOT               MG/L P      TOT  31  .494193   .338211  .581559  2.00000   .040000 78/07/12 81/03/31
 00680 T ORG C      C         MG/L             31  .322741   .011230  .105972  .558000   .148000 78/07/12 81/03/31
 00900 TOT HARD   CACO3       MG/L             11  16.3091   193.365  13.9056  52.0000   4.00000 80/03/10 80/12/02
 00940 CHLORIDE   TOTAL       MG/L             25  87.0639   1230.99  35.0855  134.700   23.2000 79/12/03 81/03/31
 00945 SULFATE   SO4-TOT      MG/L             26  6.55384   51.9952  7.21077  34.4000   1.70000 79/12/03 81/03/31
                                               11  3.39999   2.25804  1.50268  5.80000   1.60000 79/12/03 80/07/08
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                       208LCOG-0015    WQ0015          E-AC-A3WAL   FLOW0015
                                                                       44 03 14.0 123 09 13.0  2
                                                                       A-3 DRAINAGE CHANNEL AT WALLIS ROAD
                                                                       41039 OREGON                 LANE
                                                                       PACIFIC NORTHWEST            130900
 /CANAL/TYPA/AMBNT/RUNOFF                                              WILLAMETTE RIVER
                                                                       10FPACOP  800531
 INDEX 1310001  001140  01520  0210   0210                              0000  CLASS 00 CSN-RSP 0551482-0042679
 MILES 0101.50 0145.90 017.30 012.20 003.00
 PARAMETER
                                      RMK   NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM  MINIMUM  BEG DATE END DATE
 00945 SULFATE    SO4-TOT     MG/L    K          1  1.00000                    1.00000  1.00000 80/06/24 80/06/24
 00956  SILICA     TOTAL      MG/L    TOT       12  3.19999  2.53276  1.59147  5.80000  1.00000 79/12/03 80/07/08
 01002 ARSENIC    AS,TOT      UG/L               3  9.03333  2.80349  1.67436  10.0000  7.10000 78/07/12 78/10/02
                                                 4  31.0000  330.000  18.1659  43.0000  4.00000 80/08/04 80/12/02
                                      J          2  3.50000  .500000  .707107  4.00000  3.00000 80/02/11 80/09/02
 01034 CHROMIUM   CR,TOT      UG/L    TOT        6  21.8333  399.767  19.9942  43.0000  3.00000 80/02/11 80/12/02
                                                 7  15.1429  274.476  16.5673  40.0000  1.00000 80/09/02 81/01/06
                                      J         18  2.44444  4.96732  2.22875  8.00000  .000000 79/11/06 81/03/31
 01042 COPPER     CU,TOT      UG/L    TOT       25  6.00000  106.000  10.2956  40.0000  .000000 79/11/06 81/03/31
                                                12  22.0000  222.545  14.9180  46.0000  4.00000 80/05/09 81/03/31
                                      J         13  3.07692  2.41026  1.55250  6.00000  1.00000 79/11/06 80/08/04
 01045   IRON     FE,TOT      UG/L    TOT       25  12.1600  196.307  14.0109  46.0000  1.00000 79/11/06 81/03/31
 01051 LEAD       PB,TOT      UG/L              26  2340.58  2220272  1490.06  7000.00  850.000 79/11/06 81/03/31
                                                15  39.8267  1743.31  41.7529  136.000  2.00000 80/05/09 81/03/31
                                      J         11  3.81818  1.36365  1.16775  6.00000  2.00000 79/11/06 81/03/31
 01067  NICKEL    NI,TOTAL    UG/L    TOT       26  24.5923  1305.94  36.1378  136.000  2.00000 79/11/06 81/03/31
                                      J          1  130.000                    130.000  130.000 80/05/09 80/05/09
                                      K         16  100.000  .000000  .000000  100.000  100.000 79/11/06 80/10/06
 01092 ZINC       ZN,TOT      UG/L    TOT       17  101.765  52.9453  7.27635  130.000  100.000 79/11/06 80/10/06
                                                23  128.391  11098.4  105.349  402.000  12.0000 79/11/06 81/03/31
                                      J          3  10.0000  79.0000  8.88819  17.0000  .000000 80/06/10 80/08/04
 31616 FEC COLI   MFM-FCBR    /100ML  TOT       26  114.731  11260.8  106.117  402.000  .000000 79/11/06 81/03/31
                                                26  1880.38 .210E+08  4593.27  19800.0  20.0000 78/07/12 81/03/31
                                      K          1  20.0000                    20.0000  20.0000 80/02/11 80/02/11
                                      TOT       27  1811.48 .204E+08  4518.28  19800.0  20.0000 78/07/12 81/03/31
 39390 ENDRIN              TOT UG/L   K          1  .100000                    .100000  .100000 80/06/24 80/06/24
 39400 TOXAPHEN             TOTUG/L   K          1  5.00000                    5.00000  5.00000 80/06/24 80/06/24
 39480 MTHXYCLP   WHL SMPL    UG/L    K          1  .200000                    .200000  .200000 80/06/24 80/06/24
 39530 MALATHN    WHL SMPL    UG/L    K          1  10.0000                    10.0000  10.0000 80/06/24 80/06/24
 39570 DIAZINON   WHL SMPL    UG/L    K          1  2.00000                    2.00000  2.00000 80/06/24 80/06/24
 39730  2,4-D     WHL SMPL    UG/L    K          2  .100000-.372E-08  .000000  .100000  .100000 80/09/02 81/01/06
 39740 2,4,5-T    WHL SMPL    UG/L    K          2  .040000 .116E-08  .000034  .040000  .040000 80/09/02 81/01/06
 39760  SILVEX    WHL SMPL    UG/L    K          2  .040000 .116E-08  .000034  .040000  .040000 80/09/02 81/01/06
 39782 LINDANE    WHL SMPL    UG/L    K          1  .050000                    .050000  .050000 80/06/24 80/06/24
 71900 MERCURY    HG,TOTAL    UG/L               2  1.05000  .005002  .070725  1.10000  1.00000 80/12/02 80/12/02
                                      J          2  .500000  .000000  .000000  .500000  .500000 80/12/02 80/12/02
                                      K          3  .500000  .000000  .000000  .500000  .500000 79/11/06 80/10/06
                                      TOT        7  .657143  .072857  .269921  1.10000  .500000 79/11/06 80/12/02
```

192

40

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                       208LCOG-0016     WQ0016        E-POLK        FLOW0016
                                                       44 04 02.0 123 06 42.0  2
                                                       POLK STREET STORM SEWER OUTFALL - EUGENE
                                                       41039 OREGON                LANE
 /SEWER/TYPA/MUN/OUTFL/PIPE/STMSWR                     PACIFIC NORTHWEST           130900
                                                       WILLAMETTE RIVER
 INDEX 1310001  001140                                 10EPACOP  800531
 MILES 0101.50 0180.60                                  0000  CLASS 00 CSN-RSP 0551483-0042682
 PARAMETER
                                         RMK  NUMBER     MEAN  VARIANCE  STAN DEV   MAXIMUM   MINIMUM  BEG DATE END DATE
 00008   LAB      IDENT.     NUMBER               36  .000000   .000000   .000000   .000000   .000000  76/01/04 80/12/02
 00010  WATER      TEMP       CENT                13  14.4615   8.76927   2.96129   20.0000   11.5000  79/12/03 81/01/06
 00061  STREAM     FLOW,   INST-CFS               22  11.8636   113.237   10.6413   38.0000   .700000  76/05/18 81/01/06
                                          J       16  14.1687   307.208   17.5274   45.0000   .500000  76/01/04 80/12/02
                                          TOT     38  12.8342   190.144   13.7893   45.0000   .500000  76/01/04 81/01/06
 00076   TURB     TRBIDMTR   HACH FTU             13  28.8231   834.155   28.8817   70.0000   .600000  79/10/30 81/01/06
 00095 CNDUCTVY    AT 25C    MICROMHO             35  171.657   9289.55   96.3823   363.000   34.0000  76/01/04 81/01/06
 00300    DO                   MG/L               10  7.60999   .769965   .877477   8.60000   6.20000  80/01/07 81/01/06
 00315   BOD       7 DAY       MG/L               12  9.65666   256.248   16.0077   56.0000   .900000  76/04/05 80/03/10
                                          L        7  10.6286   18.2292   4.26956   16.0000   5.70000  76/09/14 76/09/27
                                          TOT     19  10.0147   162.904   12.7634   56.0000   .900000  76/04/05 80/03/10
 00324   BOD       20 DAY      MG/L                8  23.9250   175.251   13.2382   43.8000   2.00000  80/05/06 81/01/06
 00335   COD      LOWLEVEL     MG/L               31  53.5322   2869.78   53.5703   178.000   2.40000  76/01/04 81/01/06
                                          L        1  448.000                       448.000   448.000  76/09/14 76/09/14
                                          TOT     32  65.8593   7639.85   87.4063   448.000   2.40000  76/01/04 81/01/06
 00400    PH                    SU                34  6.99705   .073013   .270209   7.50000   6.40000  76/01/04 81/01/06
 00410  T ALK      CACO3       MG/L               13  75.5769   1603.97   40.0496   125.000   21.5000  79/10/30 81/01/06
 00500 RESIDUE     TOTAL       MG/L               33  209.030   7485.19   86.5170   545.000   62.0000  76/01/04 81/01/06
 00530 RESIDUE    TOT NFLT     MG/L               36  60.7444   5492.12   74.1088   271.000   .000000  76/01/04 81/01/06
 00545 RESIDUE    SETTLBLE     ML/L                5  .430000   .082000   .286356   .800000   .100000  80/12/02 80/12/02
                                          K        3  .040000   .002700   .051961   .100000   .010000  79/12/03 81/01/06
                                          TOT      8  .283750   .088369   .297270   .800000   .010000  79/12/03 81/01/06
 00556 OIL-GRSE   FREON-GR     MG/L                5  2.18000   .091999   .303313   2.60000   1.80000  80/10/06 80/12/02
                                          K        2  1.00000   .000000   .000000   1.00000   1.00000  80/03/10 80/12/02
                                          TOT      7  1.84286   .392858   .626784   2.60000   1.00000  80/03/10 80/12/02
 00610 NH3+NH4-   N TOTAL      MG/L                6  .356667   .043267   .208006   .700000   .140000  80/05/06 80/12/02
                                          K        7  .100000   .000000   .000000   .100000   .100000  79/10/30 81/01/06
                                          TOT     13  .218461   .035764   .189114   .700000   .100000  79/10/30 81/01/06
 00615  NO2-N      TOTAL       MG/L       K       12  .092500   .000675   .025981   .100000   .010000  79/12/03 81/01/06
 00625 TOT KJEL      N         MG/L                2  .085000   .000450   .021213   .100000   .070000  80/03/10 80/10/06
                                          K        4  .010000-.776E-10   .000000   .010000   .010000  80/12/02 81/01/06
                                          TOT      6  .035000   .001590   .039875   .100000   .010000  80/03/10 81/01/06
 00630 NO2&NO3    N-TOTAL      MG/L               21  1.45333   1.05892   1.02904   3.60000   .040000  76/09/08 81/01/06
 00665 PHOS-TOT               MG/L P              33  .524454   .944634   .971923   5.80000   .106000  76/04/05 81/01/06
 00680 T ORG C       C         MG/L                5  24.2600   108.738   10.4278   32.0000   7.00000  80/03/10 81/01/06
                                          K        1  1.00000                       1.00000   1.00000  80/10/06 80/10/06
                                          TOT      6  20.3833   177.162   13.3102   32.0000   1.00000  80/03/10 81/01/06
 00900 TOT HARD    CACO3       MG/L               12  66.1249   587.674   24.2420   95.2000   33.5000  76/04/05 81/01/06
 00940 CHLORIDE    TOTAL       MG/L               16  8.77812   9.33433   3.05521   13.2000   3.50000  76/04/05 81/01/06
 00945 SULFATE    SO4-TOT      MG/L                5  14.8400   37.2631   6.10435   20.8000   5.00000  79/10/30 80/07/08
 00956  SILICA     TOTAL       MG/L               20  30.2850   751.822   27.4194   112.000   1.00000  76/01/04 76/10/24
```

2- Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                    208LCOG-0016      WQ0016           E-POLK         FLOW0016
                                                    44 04 02.0 123 06 42.0  2
                                                    POLK STREET STORM SEWER OUTFALL - EUGENE
                                                    41039 OREGON                    LANE
/SEWER/TYPA/MUN/OUTFL/PIPE/STMSWR                   PACIFIC NORTHWEST               130900
                                                    WILLAMETTE RIVER
 INDEX 1310001  001140                              10EPACOP  800531
 MILES 0101.50 0180.60                               0000  CLASS 00 CSN-RSP 0551483-0042682
 PARAMETER                                 RMK  NUMBER    MEAN    VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
 01002 ARSENIC     AS,TOT        UG/L      J          4  5.00000   .666667   .816497  6.00000   4.00000 80/03/10 80/12/02
 01034 CHROMIUM    CR,TOT        UG/L                 8  2.87500   1.55357   1.24642  4.00000   1.00000 80/10/06 81/01/06
                                           J          6  3.33333   7.06668   2.65832  7.00000   .000000 79/10/30 80/07/08
 01042 COPPER      CU,TOT        UG/L      TOT       14  3.07143   3.60989   1.89997  7.00000   .000000 79/10/30 81/01/06
                                                      9  21.5555   66.7788   8.17183  31.0000   9.00000 80/05/06 81/01/06
                                           J          5  5.00000   8.50000   2.91548  9.00000   1.00000 79/10/30 80/07/08
 01045   IRON      FE,TOT        UG/L      TOT       14  15.6429   111.478   10.5583  31.0000   1.00000 79/10/30 81/01/06
                                                     12  1951.67   1987470   1409.78  4300.00   100.000 79/10/30 81/01/06
                                           J          2  51.0000   3362.00   57.9828  92.0000   10.0000 80/03/10 80/07/08
 01051 LEAD        PB,TOT        UG/L      TOT       14  1680.14   2158342   1469.13  4300.00   10.0000 79/10/30 81/01/06
                                                     10  44.8000   1137.07   33.7204  93.0000   1.00000 79/10/30 81/01/06
                                           J          4  2.00000   7.33333   2.70801  6.00000   .000000 80/01/07 80/07/08
 01067  NICKEL     NI,TOTAL      UG/L      TOT       14  32.5714   1191.50   34.5180  93.0000   .000000 79/10/30 81/01/06
 01092 ZINC        ZN,TOT        UG/L      K          7  100.000   .000000   .000000  100.000   100.000 79/10/30 80/10/06
                                                     10  67.3000   823.347   28.6940  111.000   23.0000 79/10/30 81/01/06
                                           J          4  25.0000   424.666   20.6074  46.0000   .000000 79/12/03 80/07/08
 31616 FEC COLI    MFM-FCBR      /100ML    TOT       14  55.2143   1061.26   32.5770  111.000   .000000 79/10/30 81/01/06
 39390 ENDRIN                  TOT UG/L              35  17211.4  .756E+09   27495.8  88800.0   100.000 76/01/04 81/01/06
 39400 TOXAPHEN                TOTUG/L     K          2  .100000-.372E-08   .000000  .100000   .100000 80/12/02 81/01/06
 39480 MTHXYCLR    WHL SMPL      UG/L      K          2  5.00000   .000000   .000000  5.00000   5.00000 80/12/02 81/01/06
 39530 MALATHN     WHL SMPL      UG/L      K          2  .200000   .000000   .000000  .200000   .200000 80/12/02 81/01/06
 39570 DIAZINON    WHL SMPL      UG/L      K          1  10.0000                      10.0000   10.0000 80/12/02 80/12/02
 39730  2,4-D      WHL SMPL      UG/L      K          2  2.00000   .000000   .000000  2.00000   2.00000 80/12/02 81/01/06
 39782 LINDANE     WHL SMPL      UG/L      K          1  10.0000                      10.0000   10.0000 81/01/06 81/01/06
 71900 MERCURY     HG,TOTAL      UG/L      K          2  .050000  .372E-08   .000061  .050000   .050000 80/12/02 81/01/06
                                                      1  1.30000                      1.30000   1.30000 80/12/02 80/12/02
                                           K          8  .500000   .000000   .000000  .500000   .500000 79/10/30 80/12/02
                                           TOT        9  .588889   .071111   .266667  1.30000   .500000 79/10/30 80/12/02
```

194

41

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                   208LCUG-0017     WQ0017        E-HR          FLOW0017
                                                   44 02 56.0 123 05 01.0  2
                                                   EUGENE MILL RACE AT MILL STREET
                                                   41039 OREGON                LANE
/CANAL/TYPA/AMBNT/RUNOFF                           PACIFIC NORTHWEST           130900
                                                   WILLAMETTE RIVER
INDEX 1310001  001140  01792                       10EPACOP  800531
MILES 0101.50 0182.40 000.40                        0000  CLASS 00 CSN-RSP 0551484-0042685
PARAMETER
```

ok   AS IS   2   7base

No Duplicates

```
00008    LAB      IDENT.     NUMBER     RMK  NUMBER    MEAN   VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00010   WATER      TEMP       CENT              9   .000000   .000000  .000000  .000000   .000000 76/01/05 81/01/06
00076    TURB    TRBIDMTR   HACH FTU            7   11.7143   10.5715  3.25138  16.0000   7.00000 79/10/30 81/01/06
00095 CNDUCTVY    AT 25C    MICROMHO            8   5.74999   10.8629  3.29590  11.0000   2.10000 79/10/30 81/01/06
00300     DO                  MG/L              9   63.0000   219.000  14.7986  100.000   53.0000 76/01/05 81/01/06
00315    BOD       7 DAY      MG/L              6   8.85999   3.10723  1.76273  11.0000   6.56000 80/01/07 81/01/06
00324    BOD      20 DAY      MG/L              2   2.98000   .672791  .820238  3.56000   2.40000 80/01/07 80/03/10
00335    COD     LOWLEVEL     MG/L              4   9.22500   53.6690  7.32591  19.2000   2.60000 80/05/06 81/01/06
00400     PH                   SU               8   7.71249   16.6584  4.08148  12.0000   2.80000 76/01/05 81/01/06
00410   T ALK      CACO3      MG/L              9   6.91110   .091187  .301971  7.30000   6.30000 76/01/05 81/01/06
00500 RESIDUE      TOTAL      MG/L              8   23.7875   2.51562  1.58607  26.2000   20.9000 79/10/30 81/01/06
00530 RESIDUE    TOT NFLT     MG/L              8   60.8750   152.982  12.3686  85.0000   49.0000 76/01/05 81/01/06
00545 RESIDUE    SETTLBLE     ML/L              8   6.00000   25.3257  5.03246  18.0000   2.00000 76/01/05 81/01/06
00556 OIL-GRSE   FREON-GR     MG/L       K      3   .040000   .002700  .051961  .100000   .010000 79/12/03 81/01/06
00610 NH3+NH4-    N TOTAL     MG/L              1   4.50000                     4.50000   4.50000 80/03/10 80/03/10
00615   NO2-N      TOTAL      MG/L       K      8   .100000   .000000  .000000  .100000   .100000 79/10/30 81/01/06
                                                1   .010000                     .010000   .010000 81/01/06 81/01/06
                                         K      6   .100000-.223E-08  .000000  .100000   .100000 79/12/03 80/10/06
                                         TOT    7   .081143   .001157  .034017  .100000   .010000 79/12/03 81/01/06
00625 TOT KJEL       N        MG/L              1   .190000                     .190000   .190000 80/03/10 80/03/10
00630 NO2&NO3    N-TOTAL      MG/L              4   .130000   .002267  .047610  .200000   .100000 79/12/03 81/01/06
                                         K      3   .100000-.186E-08  .000000  .100000   .100000 80/05/06 80/10/06
                                         TOT    7   .117143   .001390  .037289  .200000   .100000 79/12/03 81/01/06
00665 PHOS-TOT               MG/L P             7   .061143   .000701  .026473  .103000   .036000 79/12/03 81/01/06
00680 T ORG C        C        MG/L              1   6.80000                     6.80000   6.80000 80/03/10 80/03/10
00900 TOT HARD     CACO3      MG/L              6   21.3500   6.15513  2.48095  25.7000   19.2000 79/10/30 81/01/06
00940 CHLORIDE     TOTAL      MG/L              6   1.37500   .125751  .354615  1.95000   1.00000 79/10/30 81/01/06
00945 SULFATE     SO4-TOT     MG/L              2   1.80000   .020002  .141430  1.90000   1.70000 79/10/30 80/01/07
                                         K      2   1.00000   .000000  .000000  1.00000   1.00000 80/03/10 80/07/08
                                         TOT    4   1.40000   .220000  .469042  1.90000   1.00000 79/10/30 80/07/08
00956  SILICA      TOTAL      MG/L              1   40.0000                     40.0000   40.0000 76/01/05 76/01/05
01034 CHROMIUM    CR,TOT      UG/L       J      7   .571429   .952381  .975900  2.00000   .000000 79/10/30 81/01/06
01042 COPPER      CU,TOT      UG/L              2   3.00000   2.00000  1.41421  4.00000   2.00000 80/10/06 81/01/06
                                         J      5   2.80000   4.70001  2.16795  5.00000   .000000 79/10/30 80/07/08
                                         TOT    7   2.85714   3.47620  1.86446  5.00000   .000000 79/10/30 81/01/06
01045    IRON     FE,TOT      UG/L              6   478.166   60100.4  245.154  769.000   200.000 79/10/30 81/01/06
                                         J      1   40.0000                     40.0000   40.0000 80/07/08 80/07/08
                                         TOT    7   415.571   77510.8  278.408  769.000   40.0000 79/10/30 81/01/06
01051 LEAD        PB,TOT      UG/L              3   16.6667   357.334  18.9033  38.0000   2.00000 80/01/07 81/01/06
                                         J      4   2.75000   4.91667  2.21736  5.00000   .000000 79/10/30 80/07/08
                                         TOT    7   8.71428   176.905  13.3006  38.0000   .000000 79/10/30 81/01/06
01067  NICKEL    NI,TOTAL     UG/L       K      6   100.000   .000000  .000000  100.000   100.000 79/10/30 80/10/06
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                         20BLCOG-0017        WO0017          E-MR          FLOW0017
                                                         44 02 56.0 123 05 01.0  2
                                                         EUGENE MILL RACE AT MILL STREET
                                                         41039 OREGON              LANE
/CANAL/TYPA/AMBNT/RUNOFF                                 PACIFIC NORTHWEST         130900
                                                         WILLAMETTE RIVER
INDEX 1310001  001140  01792                             10EPACOP  800531
MILES 0101.50 0182.40 000.40                              0000  CLASS 00 CSN-RSP 0551484-0042685
PARAMETER
01092 ZINC        ZN,TOT      UG/L     RMK  NUMBER    MEAN    VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
                                                 2  5.00000   50.0000  7.07107   10.0000   .000000  80/10/06 81/01/06
                                       J         5  8.00000   98.5000  9.92472   22.0000   .000000  79/10/30 80/07/08
                                       TOT       7  7.14286   76.1429  8.72599   22.0000   .000000  79/10/30 81/01/06
31616 FEC COLI    MFM-FCBR    /100ML             7  554.286   74628.6  273.182   1000.00   200.000  76/01/05 81/01/06
                                       L         1  4000.00                      4000.00   4000.00  79/12/03 79/12/03
                                       TOT       8  985.000   1548085  1244.22   4000.00   200.000  76/01/05 81/01/06
71900 MERCURY     HG,TOTAL    UG/L     K         3  .500000   .000000  .000000   .500000   .500000  79/10/30 80/10/06
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                        208LCOG-0018      W00018          E-WIL-VRB
                                                        44 04 05.0 123 06 43.0  2
                                                        WILLAMETTE R. AT VALLEY RIVER FOOTBRIDGE
                                                        41039 OREGON                 LANE
                                                        PACIFIC NORTHWEST            130900
/TYPA/AMBNT/STREAM/RUNOFF                               WILLAMETTE RIVER
                                                        10EPACUP  800531
INDEX 1310001  001140                                    0000  CLASS 00 CSN-RSP 0551485-0042686
MILES 0101.50 0180.50
PARAMETER
                                          RMK  NUMBER    MEAN    VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00008   LAB      IDENT.     NUMBER                11  .000000   .000000  .000000  .000000  .000000 76/10/06 81/01/06
00010  WATER      TEMP       CENT                  9  11.5667   23.1176  4.80807  17.0000  6.00000 80/01/07 80/11/04
00060  STREAM     FLOW       CFS                  10  3856.00   8462869  2909.10  9300.00  1630.00 79/12/03 80/11/04
                                           J       2  7835.00   6734448  2595.08  9670.00  6000.00 76/10/06 81/01/06
                                          TOT     12  4519.16   9935249  3152.02  9670.00  1630.00 76/10/06 81/01/06
~~00070   TURB     JKSN       JTU                  1  2.00000                      2.00000  2.00000 80/08/04 80/08/04~~< error — f.7E Del
00076   TURB    TRBIDMTR   HACH FTU               11  7.13636   43.7245  6.61245  24.0000  2.00000 79/12/03 81/01/06
00095 CNDUCTVY   AT 25C    MICROMHO               12  68.3333   1973.34  44.4222  204.000  35.0000 76/10/06 81/01/06
00300    DO                  MG/L                  9  10.8467   .711700  .843623  12.2000  9.60000 80/01/07 80/11/04
00315   BOD       7 DAY      MG/L                  4  2.86500   .062236  .249470  3.20000  2.60000 80/01/07 80/03/10
00324   BOD      20 DAY      MG/L                  5  7.25999   36.7130  6.05913  15.1000  1.30000 80/06/10 80/11/04
00335   COD     LOWLEVEL     MG/L                 11  5.23636   3.89453  1.97346  7.40000  .300000 79/12/03 81/01/06
~~00340   COD     HI LEVEL     MG/L                  1  5.20000                      5.20000  5.20000 80/08/04 80/08/04~~<Error = 33E Del
00400    PH                   SU                  11  7.10908   .156934  .396148  7.80000  6.50000 79/12/03 81/01/06
00410  T ALK     CACO3       MG/L                 10  28.5200   245.530  15.6694  72.3000  20.9000 79/12/03 81/01/06
                                           J       1  20.5000                      20.5000  20.5000 80/01/07 80/01/07
                                          TOT     11  27.7909   226.824  15.0607  72.3000  20.5000 79/12/03 81/01/06
00500 RESIDUE     TOTAL      MG/L                 12  63.4167   709.904  26.6440  130.000  40.0000 76/10/06 81/01/06
00530 RESIDUE    TOT NFLT    MG/L                 10  4.88000   18.0106  4.24389  16.8000  2.00000 79/12/03 81/01/06
00545 RESIDUE    SETTLBLE    ML/L          K       6  .025000   .001350  .036742  .100000  .010000 79/12/03 81/01/06
00556 OIL-GRSE   FREON-GR    MG/L          K       1  1.00000                      1.00000  1.00000 80/03/10 80/03/10
00610 NH3+NH4-   N TOTAL     MG/L          K      11  .100000  .178E-07  .000134  .100000  .100000 79/12/03 81/01/06
00615  NO2-N      TOTAL      MG/L                  1  .010000                      .010000  .010000 81/01/06 81/01/06
                                           K      10  .100000   .000000  .000000  .100000  .100000 79/12/03 80/11/04
                                          TOT     11  .091818   .000736  .027136  .100000  .010000 79/12/03 81/01/06
00625 TOT KJEL      N        MG/L                  1  .110000                      .110000  .110000 80/03/10 80/03/10
                                           K       2  .010000-.145E-10  .000000  .010000  .010000 80/11/04 81/01/06
                                          TOT      3  .043333   .003333  .057735  .110000  .010000 80/03/10 81/01/06
00630 NO2&NO3    N-TOTAL     MG/L                  8  .280000   .073743  .271556  .800000  .040000 76/10/06 81/01/06
                                           K       4  .100000-.248E-08  .000000  .100000  .100000 80/06/10 80/10/08
                                          TOT     12  .220000   .054782  .234055  .800000  .040000 76/10/06 81/01/06
~~00650  T PO4      PO4        MG/L                  1  .050000                      .050000  .050000 80/08/04 80/08/04~~<—— Del
00665 PHOS-TOT              MG/L P                12  .060917   .000274  .016561  .103000  .050000 76/10/06 81/01/06
00680 T ORG C       C        MG/L                  3  8.96666   52.1733  7.22311  17.1000  3.30000 80/03/10 81/01/06
                                           K       1  1.00000                      1.00000  1.00000 80/11/04 80/11/04
                                          TOT      4  6.97499   50.6491  7.11682  17.1000  1.00000 80/03/10 81/01/06
00900 TOT HARD   CACO3       MG/L                  9  25.2555   191.855  13.8512  61.2000  18.7000 79/12/03 81/01/06
00940 CHLORIDE    TOTAL      MG/L                  8  1.69375   2.78317  1.66828  5.70000  .700000 80/01/07 81/01/06
00945 SULFATE    SO4-TOT     MG/L                  2  4.35000   22.4450  4.73762  7.70000  1.00000 80/02/11 80/03/10
                                           K       2  1.00000   .000000  .000000  1.00000  1.00000 80/01/07 80/07/08
                                          TOT      4  2.67500   11.2225  3.35000  7.70000  1.00000 80/01/07 80/07/08
```

1 Duplicate

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                           208LCOG-0018     WQ0018        E-WIL-VRB
                                                           44 04 05.0 123 06 43.0  2
                                                           WILLAMETTE R. AT VALLEY RIVER FOOTBRIDGE
                                                           41039 OREGON                 LANE
/TYPA/AMBNT/STREAM/RUNOFF                                  PACIFIC NORTHWEST            130900
                                                           WILLAMETTE RIVER
INDEX 1310001  001140                                      10EPACOP  800531
MILES 0101.50 0180.50                                       0000  CLASS 00 CSN-RSP 0551485-0042686
PARAMETER
                                   RMK  NUMBER     MEAN   VARIANCE STAN DEV  MAXIMUM   MINIMUM BEG DATE END DATE
00956  SILICA     TOTAL     MG/L             1  1.80000                     1.80000   1.80000 76/10/06 76/10/06
01002 ARSENIC     AS,TOT    UG/L    J        3  2.33333  1.33334  1.15470   3.00000   1.00000 80/02/11 80/08/04
01034 CHROMIUM    CR,TOT    UG/L    J       10  .300000  .455556  .674949   2.00000   .000000 79/12/03 81/01/06
01042 COPPER      CU,TOT    UG/L             2  1.00000  .000000  .000000   1.00000   1.00000 80/10/08 81/01/06
                                    J        8  1.62500  1.69643  1.30247   4.00000   .000000 79/12/03 80/08/04
                                    TOT     10  1.50000  1.38889  1.17851   4.00000   .000000 79/12/03 81/01/06
01045   IRON      FE,TOT    UG/L            11  570.000   348640  590.458   2200.00   100.000 79/12/03 81/01/06
01051 LEAD        PB,TOT    UG/L             3  1.33333  2.33333  1.52753   3.00000   .000000 80/07/08 80/11/04
                                    J        8  1.37500  2.55357  1.59799   4.00000   .000000 79/12/03 81/01/06
                                    TOT     11  1.36364  2.25455  1.50152   4.00000   .000000 79/12/03 81/01/06
01067  NICKEL     NI,TOTAL  UG/L    K        9  100.000  .000000  .000000   100.000   100.000 79/12/03 80/10/08
01092 ZINC        ZN,TOT    UG/L             1  .000000                     .000000   .000000 81/01/06 81/01/06
                                    J        9  8.22222  37.9445  6.15991   21.0000   1.00000 79/12/03 80/10/08
                                    TOT     10  7.40000  40.4889  6.36309   21.0000   .000000 79/12/03 81/01/06
31616 FEC COLI    MFM-FCBR  /100ML           8  410.000   299229  547.018   1630.00   20.0000 76/10/06 80/11/04
                                    J        1  5000.00                     5000.00   5000.00 79/12/03 79/12/03
                                    K        2  20.0000  .000000  .000000   20.0000   20.0000 80/07/08 81/01/06
                                    TOT     11  756.364  2214724  1488.19   5000.00   20.0000 76/10/06 81/01/06
71900 MERCURY     HG,TOTAL  UG/L    J        1  .500000                     .500000   .500000 80/10/08 80/10/08
                                    K        1  .500000                     .500000   .500000 79/12/03 79/12/03
                                    TOT      2  .500000  .000000  .000000   .500000   .500000 79/12/03 80/10/08
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                     208LCOG-0020     WQ0020        E-WIL-AB
                                                     44 03 04.0 123 04 10.0  2
                                                     WILLAMETTE R. AT AUTZEN FOOTBRIDGE, EUGENE
                                                     41039 OREGON              LANE
/TYPA/AMBNT/STREAM/RUNOFF                            PACIFIC NORTHWEST         130900
                                                     WILLAMETTE RIVER
INDEX 1310001  001140                                10EPACOP  800531
MILES 0101.50 0183.00                                 0000  CLASS 00 CSN-RSP 0551487-0042689
PARAMETER
                                          RMK   NUMBER    MEAN   VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00008    LAB      IDENT.      NUMBER
00010   WATER      TEMP        CENT                7  .000000   .000000   .000000   .000000   .000000 76/10/06 81/01/06
00060   STREAM     FLOW        CFS                 5  10.8000   23.7001   4.86827   17.0000   6.00000 80/01/07 81/01/06
                                                   6  6093.33  .130E+08   3612.27   9670.00   1630.00 79/12/03 81/01/06
                                          J        1  6000.00                       6000.00   6000.00 76/10/06 76/10/06
00076    TURB     TRBIDMTR    HACH FTU    TOT      7  6080.00  .108E+08   3297.72   9670.00   1630.00 76/10/06 81/01/06
00095 CNDUCTVY     AT 25C     MICROMHO             6  9.89999   72.9640   8.54190   25.0000   2.30000 79/12/03 81/01/06
00300     DO                    MG/L               7  53.0000   84.0000   9.16515   68.0000   38.0000 76/10/06 81/01/06
00315    BOD       7 DAY        MG/L               2  10.5500   1.12515   1.06073   11.3000   9.80000 80/03/10 80/07/08
00324    BOD      20 DAY        MG/L               1  3.30000                       3.30000   3.30000 80/03/10 80/03/10
00335    COD     LOWLEVEL       MG/L               1  3.20000                       3.20000   3.20000 80/07/08 80/07/08
00400     PH                     SU                6  6.88333   9.00576   3.00096   12.1000   3.60000 79/12/03 81/01/06
00410  T ALK       CACO3        MG/L               6  6.99999   .052100   .228253   7.20000   6.60000 79/12/03 81/01/06
00500 RESIDUE      TOTAL        MG/L               6  22.2833   3.91387   1.97835   24.4000   19.2000 79/12/03 81/01/06
00530 RESIDUE    TOT NFLT       MG/L               6  65.1667   194.971   13.9632   89.0000   51.0000 79/12/03 81/01/06
00545 RESIDUE    SETTLBLE       ML/L               5  6.71999   48.1719   6.94060   18.8000   1.00000 79/12/03 81/01/06
00556 OIL-GRSE   FREON-GR       MG/L      K        3  .040000   .002700   .051961   .100000   .010000 79/12/03 81/01/06
00610 NH3+NH4-   N TOTAL        MG/L      K        1  1.00000                       1.00000   1.00000 80/03/10 80/03/10
                                                   1  .200000                       .200000   .200000 80/07/08 80/07/08
                                          K        5  .100000-.279E-08   .000000   .100000   .100000 79/12/03 81/01/06
00615  NO2-N       TOTAL        MG/L      TOT      6  .116667   .001667   .040825   .200000   .100000 79/12/03 81/01/06
                                                   1  .010000                       .010000   .010000 81/01/06 81/01/06
                                          K        5  .100000-.279E-08   .000000   .100000   .100000 79/12/03 80/10/08
00625 TOT KJEL       N                    TOT      6  .085000   .001350   .036742   .100000   .010000 79/12/03 81/01/06
00630 NO2&NO3    N-TOTAL        MG/L               1  .630000                       .630000   .630000 80/03/10 80/03/10
                                MG/L               5  .130000   .005200   .072111   .200000   .030000 76/10/06 81/01/06
                                          K        2  .100000-.372E-08   .000000   .100000   .100000 80/07/08 80/10/08
00665 PHOS-TOT                            TOT      7  .121428   .003681   .060671   .200000   .030000 76/10/06 81/01/06
00680 T ORG C        C          MG/L P             7  .066571   .000638   .025258   .108000   .036000 76/10/06 81/01/06
00900 TOT HARD     CACO3        MG/L               1  4.10000                       4.10000   4.10000 80/03/10 80/03/10
00940 CHLORIDE     TOTAL        MG/L               5  19.4800   3.77197   1.94216   21.9000   16.5000 79/12/03 81/01/06
00945 SULFATE     SO4-TOT       MG/L               4  1.22500   .035834   .189298   1.50000   1.10000 80/01/07 81/01/06
00956  SILICA      TOTAL        MG/L      K        3  1.00000   .000000   .000000   1.00000   1.00000 80/01/07 80/07/08
01002 ARSENIC     AS,TOT        UG/L               1  2.70000                       2.70000   2.70000 76/10/06 76/10/06
01034 CHROMIUM    CR,TOT        UG/L      K        1  10.0000                       10.0000   10.0000 80/03/10 80/03/10
01042 COPPER      CU,TOT        UG/L      J        2  1.00000   2.00000   1.41421   2.00000   .000000 79/12/03 80/03/10
01045   IRON      FE,TOT        UG/L      J        2  2.50000   4.50000   2.12132   4.00000   1.00000 79/12/03 80/03/10
01051 LEAD        PB,TOT        UG/L               2  1655.00   1786050   1336.43   2600.00   710.000 79/12/03 80/03/10
01067  NICKEL    NI,TOTAL       UG/L      J        2  1.00000   2.00000   1.41421   2.00000   .000000 79/12/03 80/03/10
01092 ZINC        ZN,TOT        UG/L      K        3  100.000   .000000   .000000   100.000   100.000 79/12/03 80/03/10
31616 FEC COLI   MFM-FCBR      /100ML     J        2  3.50000   .500000   .707107   4.00000   3.00000 79/12/03 80/03/10
                                                   5  302.000    111620   334.096   860.000   20.0000 79/12/03 80/10/08
```

No Duplicates

199

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                        20RLCOG-0020      WQ0020          E-WIL-AB
                                                        44 03 04.0 123 04 10.0  2
                                                        WILLAMETTE R, AT AUTZEN FOOTBRIDGE, EUGENE
                                                        41039 OREGON               LANE
 /TYPA/AMBNT/STREAM/RUNOFF                              PACIFIC NORTHWEST          130900
                                                        WILLAMETTE RIVER
 INDEX 1310001  001140                                  10FPACOP  800531
 MILES 0101.50 0183.00                                  0000  CLASS 00 CSN-RSP 0551487-0042689
 PARAMETER
 31616 FEC COLI     MFM-FCBR    /100ML     RMK  NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM  MINIMUM  BEG DATE END DATE
                                           K         1  20.0000                     20.0000  20.0000 81/01/06 81/01/06
 71900 MERCURY      HG,TOTAL     UG/L      TOT       6  255.000   102550  320.234   860.000  20.0000 79/12/03 81/01/06
                                           K         1  .500000                     .500000  .500000 79/12/03 79/12/03
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                              208LCUG-0021    W00021       S-WIL-126
                                              44 02 42.0 123 01 40.0  2
                                              WILLAMETTE R. AT HWY 126 BRIDGE, SPRINGFIELD
                                              41039 OREGON                LANE
                                              PACIFIC NORTHWEST           130900
/TYPA/AMBNT/STREAM/RUNOFF                     WILLAMETTE RIVER
                                              10EPACOP  800531
INDEX 1310001  001140                          0000  CLASS 00 CSN-RSP 0551488-0042690
MILES 0101.50 0185.30
PARAMETER
00008   LAB       IDENT.      NUMBER     RMK  NUMBER    MEAN   VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00010  WATER       TEMP        CENT              11  .000000   .000000   .000000   .000000   .000000 76/10/06 81/01/06
00060  STREAM      FLOW        CFS                7  11.4429   16.9062   4.11172   17.0000   6.00000 80/01/07 81/01/06
                                                 10  4627.00  .111E+08   3340.48   9670.00   1630.00 79/12/03 81/01/06
                                          J       1  6000.00                       6000.00   6000.00 76/10/06 76/10/06
00070   TURB       JKSN        JTU       TOT     11  4751.82  .102E+08   3195.98   9670.00   1630.00 76/10/06 81/01/06
00076   TURB     TRBIDMTR    HACH FTU             1  2.50000                       2.50000   2.50000 80/08/04 80/08/04 ← Del
00095 CNDUCTVY    AT 25C     MICROMHO            10  8.13000   69.6090   8.34320   29.0000   2.40000 79/12/03 81/01/06
00300    DO                    MG/L              11  53.4545   8.07422   2.84152   58.0000   48.0000 76/10/06 81/01/06
00315   BOD       7 DAY        MG/L               7  10.3543   1.77803   1.33343   12.1000   8.00000 80/01/07 80/11/04
00324   BOD       20 DAY       MG/L               3  2.26667   .003337   .057766   2.30000   2.20000 80/01/07 80/03/10
00335   COD      LOWLEVEL      MG/L               4  3.95000   14.6233   3.82405   9.60000   1.20000 80/06/10 80/11/04
00340   COD      HI LEVEL      MG/L              10  5.44999   11.5539   3.39910   13.0000   1.30000 79/12/03 81/01/06
00400    PH                    SU                 1  3.70000                       3.70000   3.70000 80/08/04 80/08/04 ← Del
00410  T ALK      CACO3        MG/L              10  7.00999   .061008   .246998   7.30000   6.60000 79/12/03 81/01/06
00500 RESIDUE     TOTAL        MG/L              10  21.8900   2.90365   1.70401   24.9000   18.9000 79/12/03 81/01/06
00530 RESIDUE    TOT NFLT      MG/L              11  57.2727   136.820   11.6970   89.0000   49.0000 76/10/06 81/01/06
00545 RESIDUE    SETTLBLE      ML/L               9  4.31111   21.9711   4.68733   16.0000   1.00000 79/12/03 81/01/06
00556 OIL-GRSE   FREON-GR      MG/L       K       4  .032500   .002025   .045000   .100000   .010000 79/12/03 81/01/06
00610 NH3+NH4-   N TOTAL       MG/L               1  1.90000                       1.90000   1.90000 80/03/10 80/03/10
00615  NO2-N      TOTAL        MG/L       K      10  .091000   .000810   .028460   .100000   .010000 79/12/03 81/01/06
                                                  1  .010000                       .010000   .010000 81/01/06 81/01/06
                                          K       9  .100000   .000000   .000000   .100000   .100000 79/12/03 80/11/04
00625 TOT KJEL      N          MG/L      TOT     10  .091000   .000810   .028460   .100000   .010000 79/12/03 81/01/06
                                                  2  .160000   .000200   .014142   .170000   .150000 80/03/10 80/11/04
                                          K       1  .010000                       .010000   .010000 81/01/06 81/01/06
00630 NO2&NO3    N-TOTAL       MG/L      TOT      3  .110000   .007600   .087178   .170000   .010000 80/03/10 81/01/06
                                                  7  .157143   .013490   .116149   .300000   .020000 76/10/06 81/01/06
                                          K       4  .100000-.248E-08   .000000   .100000   .100000 80/06/10 80/10/08
00650) T PO4       PO4         MG/L      TOT     11  .136363   .008925   .094475   .300000   .020000 76/10/06 81/01/06
00665 PHOS-TOT                 MG/L P             1  .030000                       .030000   .030000 80/08/04 80/08/04 ←DEL
00680 T ORG C       C          MG/L              11  .044545   .000323   .017974   .086000   .022000 76/10/06 81/01/06
                                                  2  7.25000   .005005   .070745   7.30000   7.20000 80/03/10 81/01/06
                                          K       2  1.00000   .000000   .000000   1.00000   1.00000 80/08/04 80/11/04
00900 TOT HARD    CACO3        MG/L      TOT      4  4.12500   13.0225   3.60867   7.30000   1.00000 80/03/10 81/01/06
00940 CHLORIDE    TOTAL        MG/L               8  19.2125   2.07258   1.43965   21.2000   16.4000 79/12/03 81/01/06
00945 SULFATE    SO4-TOT       MG/L               8  1.10625   .078885   .280865   1.45000   .700000 80/01/07 81/01/06
00956  SILICA     TOTAL        MG/L       K       3  1.00000   .000000   .000000   1.00000   1.00000 80/01/07 80/07/08
01002 ARSENIC    AS,TOT        UG/L               1  2.70000                       2.70000   2.70000 76/10/06 76/10/06
01034 CHROMIUM   CR,TOT        UG/L       J       3  1.66667   2.33334   1.52753   3.00000   .000000 80/02/11 80/08/04
01042 COPPER     CU,TOT        UG/L       J       8  .500000   .571429   .755929   2.00000   .000000 79/12/03 80/10/08
                                          J       8  1.62500   3.69643   1.92261   6.00000   .000000 79/12/03 80/10/08
```

No Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                    208LCOG-0021       WQ0021          S-WIL-126
                                                    44 02 42.0 123 01 40.0  2
                                                    WILLAMETTE R. AT HWY 126 BRIDGE, SPRINGFIELD
                                                    41039 OREGON                LANE
/TYPA/AMBNT/STREAM/RUNOFF                           PACIFIC NORTHWEST           130900
                                                    WILLAMETTE RIVER
INDEX 1310001  001140                               10EPACOP  800531
MILES 0101.50 0185.30                                0000  CLASS 00 CSN-RSP 0551488-0042690
PARAMETER
                                    RMK  NUMBER   MEAN    VARIANCE STAN DEV MAXIMUM  MINIMUM  REG DATE END DATE
01045   IRON    FE,TOT      UG/L            9  742.889   1095470  1046.65  3400.00  80.0000 79/12/03 80/11/04
01051 LEAD      PB,TOT      UG/L            3  1.00000   .000000  .000000  1.00000  1.00000 80/07/08 80/11/04
                                    J       6  2.50000   9.50000  3.08221  8.00000  .000000 79/12/03 80/08/04
                                    TOT     9  2.00000   6.50000  2.54951  8.00000  .000000 79/12/03 80/11/04
01067  NICKEL   NI,TOTAL    UG/L    K       8  100.000   .000000  .000000  100.000  100.000 79/12/03 80/10/08
01092 ZINC      ZN,TOT      UG/L    J       8  6.00000   20.0000  4.47214  12.0000  1.00000 79/12/03 80/10/08
31616 FEC COLI  MFM-FCBR    /100ML          9  92.2222   12619.5  112.336  380.000  20.0000 76/10/06 81/01/06
                                    K       1  20.0000                     20.0000  20.0000 80/07/08 80/07/08
                                    TOT    10  85.0000   11738.9  108.346  380.000  20.0000 76/10/06 81/01/06
71900 MERCURY   HG,TOTAL    UG/L    J       1  .500000                     .500000  .500000 80/10/08 80/10/08
                                    K       1  .500000                     .500000  .500000 79/12/03 79/12/03
                                    TOT     2  .500000   .000000  .000000  .500000  .500000 79/12/03 80/10/08
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                      208LCOG-0022    W00022         5-MR          FLOW0022
                                                                     44 02 42.0 123 01 30.0  2
                                                                     SPRINGFIELD MILL RACE NEAR MOUTH
                                                                     41039 OREGON                LANE
                                                                     PACIFIC NORTHWEST           130900
                                                                     WILLAMETTE RIVER
/CANAL/TYPA/AMBNT/RUNOFF                                             10EPACOP  800531
                                                                      0000  CLASS 00 CSN-RSP 0551489-0042692
INDEX 1310001  001140  01799
MILES 0101.50 0185.35 000.05
PARAMETER                                RMK  NUMBER     MEAN   VARIANCE  STAN DEV   MAXIMUM    MINIMUM  BEG DATE END DATE
00008   LAB      IDENT.    NUMBER                 24  .000000    .000000   .000000   .000000    .000000  77/02/20 81/03/31
00010  WATER      TEMP      CENT                  21  13.0476    14.1978   3.76800   19.0000    8.00000  79/10/30 81/03/31
                                          J        2  10.5000    .500000   .707107   11.0000    10.0000  80/11/21 81/03/31
                                          TOT     23  12.8261    13.4685   3.66995   19.0000    8.00000  79/10/30 81/03/31
00061  STREAM     FLOW,    INST-CFS               20  82.1000    4954.73   70.3898   300.000    21.0000  79/12/10 81/03/31
                                          J        1  45.0000                        45.0000    45.0000  81/01/06 81/01/06
                                          TOT     21  80.3333    4772.53   69.0835   300.000    21.0000  79/12/10 81/03/31
00076   TURB     TRBIDMTR  HACH FTU               21  9.50000    81.9490   9.05257   36.0000    2.90000  79/10/30 81/03/31
00095 CNDUCTVY    AT 25C   MICROMHO               23  58.2609    139.932   11.8293   105.000    47.0000  78/04/18 81/03/31
00300    DO                  MG/L                 14  9.51999    1.38101   1.17516   11.6000    7.30000  80/01/14 81/03/31
00315   BOD       7 DAY      MG/L                  4  4.07000    4.03693   2.00921   6.40000    1.90000  77/02/20 80/03/10
00324   BOD      20 DAY      MG/L                 11  7.47272    34.9622   5.91288   20.5000    1.30000  80/05/06 81/03/31
00335   COD      LOWLEVEL    MG/L                 24  12.3750    152.059   12.3312   51.4000    .700000  77/02/20 81/03/31
00400    PH                   SU                  24  6.89166    .074696   .273306   7.40000    6.40000  77/02/20 81/03/31
00410  T ALK      CACO3      MG/L                 22  23.5636    5.18415   2.27687   28.6000    20.1000  79/10/30 81/03/31
00500 RESIDUE     TOTAL      MG/L                 23  68.0869    676.270   26.0052   124.000    44.0000  77/02/20 81/03/31
00530 RESIDUE    TOT NFLT    MG/L                 19  14.3053    335.468   18.3158   66.0000    .000000  77/02/20 81/03/31
00545 RESIDUE    SETTLBLE    ML/L                  4  .090000    .006733   .082057   .200000    .010000  77/02/20 80/11/21
                                          J        1  .010000                        .010000    .010000  80/01/14 80/01/14
                                          K        9  .020000    .000900   .030000   .100000    .010000  79/12/10 81/03/31
                                          TOT     14  .039286    .003223   .056767   .200000    .010000  77/02/20 81/03/31
00556 OIL-GRSE   FREON-GR    MG/L                  3  1.83333    .043333   .208166   2.00000    1.60000  80/09/02 80/11/21
                                          K        3  1.00000    .000000   .000000   1.00000    1.00000  80/03/10 80/11/21
                                          TOT      6  1.41667    .225668   .475045   2.00000    1.00000  80/03/10 80/11/21
00610 NH3+NH4-   N TOTAL     MG/L         K       22  .095909    .000368   .019190   .100000    .010000  79/10/30 81/03/31
00615  NO2-N      TOTAL      MG/L                  5  .030000    .001550   .039370   .100000    .010000  80/09/02 81/03/31
                                          K       14  .093571    .000579   .024054   .100000    .010000  79/12/10 80/11/21
                                          TOT     19  .076842    .001589   .039868   .100000    .010000  79/12/10 81/03/31
00625 TOT KJEL      N        MG/L                  5  .415999    .600829   .775132   1.80000    .010000  80/03/10 80/11/21
                                          K        3  .016667    .000033   .005773   .020000    .010000  80/09/02 81/01/06
                                          TOT      8  .266250    .386055   .621333   1.80000    .010000  80/03/10 81/01/06
00630 NO2&NO3    N-TOTAL     MG/L                 15  .194000    .068968   .262618   1.00000    .040000  77/02/20 81/03/31
                                          K        9  .100000    .000000   .000000   .100000    .100000  80/03/10 80/10/08
                                          TOT     24  .158750    .044142   .210099   1.00000    .040000  77/02/20 81/03/31
00665 PHOS-TOT               MG/L P               24  .084000    .004610   .067895   .293000    .031000  77/02/20 81/03/31
00680 T ORG C       C        MG/L                  6  6.10000    22.1880   4.71042   15.0000    1.10000  80/03/10 81/01/06
                                          K        3  1.00000    .000000   .000000   1.00000    1.00000  80/09/02 80/11/04
                                          TOT      9  4.40000    20.3700   4.51331   15.0000    1.00000  80/03/10 81/01/06
00900 TOT HARD    CACO3      MG/L                 20  21.0900    5.26295   2.29411   28.8000    19.0000  79/10/30 81/03/31
00940 CHLORIDE    TOTAL      MG/L                 21  1.03095    .128622   .358639   2.00000    .600000  79/10/30 81/03/31
00945 SULFATE    SO4-TOT     MG/L                  2  .850000    .005001   .070718   .900000    .800000  79/10/30 79/12/10
```

No Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                             208LCOG-0022      WQ0022           S-MR          FLOW0022
                                                             44 02 42.0 123 01 30.0  2
                                                             SPRINGFIELD MILL RACE NEAR MOUTH
                                                             41039 OREGON                   LANE
                                                             PACIFIC NORTHWEST              130900
 /CANAL/TYPA/AMBNT/RUNOFF                                    WILLAMETTE RIVER
                                                             10EPACUP  800531
 INDEX 1310001  001140  01799                                 0000  CLASS 00 CSN-RSP 0551489-0042692
 MILES 0101.50 0185.35 000.05
 PARAMETER                                 RMK   NUMBER    MEAN   VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
 00945 SULFATE     SO4-TOT      MG/L       K          3  1.00000  .000000   .000000  1.00000   1.00000  80/01/14 80/07/08
                                           TOT        5  .940000  .008000   .089445  1.00000   .800000  79/10/30 80/07/08
 00956  SILICA      TOTAL       MG/L                  2  54.0000  128.000   11.3137  62.0000   46.0000  77/02/20 77/02/21
 01002 ARSENIC     AS,TOT       UG/L       J          4  2.25000  2.91667   1.70782  4.00000   .000000  80/08/04 80/11/21
 01034 CHROMIUM    CR,TOT       UG/L                  2  4.00000  2.00000   1.41421  5.00000   3.00000  80/11/21 80/11/21
                                           J         15  .266667  .209524   .457738  1.00000   .000000  79/10/30 81/03/31
                                           TOT       17  .705882  1.84559   1.35852  5.00000   .000000  79/10/30 81/03/31
 01042 COPPER      CU,TOT       UG/L                  5  8.60000  52.3000   7.23188  19.0000   1.00000  80/09/02 81/01/06
                                           J         12  2.00000  2.54545   1.59545  5.00000   .000000  79/10/30 81/03/31
                                           TOT       17  3.94118  24.4338   4.94306  19.0000   .000000  79/10/30 81/03/31
 01045   IRON      FE,TOT       UG/L                 17  808.235   810177   900.098  3300.00   100.000  79/10/30 81/03/31
                                           J          1  10.0000                     10.0000   10.0000  80/07/08 80/07/08
                                           TOT       18  763.889   797918   893.263  3300.00   10.0000  79/10/30 81/03/31
 01051 LEAD        PB,TOT       UG/L                  9  17.8444  484.318   22.0072  67.0000   .000000  80/01/14 81/03/31
                                           J          9  1.11111  1.11111   1.05409  3.00000   .000000  79/10/30 81/03/31
                                           TOT       18  9.47778  302.556   17.3941  67.0000   .000000  79/10/30 81/03/31
 01067  NICKEL     NI,TOTAL     UG/L       K         11  100.000  .000000   .000000  100.000   100.000  79/10/30 80/10/08
 01092 ZINC        ZN,TOT       UG/L                  5  36.2000  815.201   28.5517  67.0000   .000000  80/09/02 81/01/06
                                           J         12  8.83333  66.1515   8.13336  28.0000   1.00000  79/10/30 81/03/31
                                           TOT       17  16.8823  414.486   20.3589  67.0000   .000000  79/10/30 81/03/31
 31616 FEC COLI    MFM-FCBR     /100ML               18  1240.28  5517265   2348.89  8000.00   10.0000  77/02/20 81/03/31
                                           J          1  16000.0                     16000.0   16000.0  79/12/10 79/12/10
                                           K          1  20.0000                     20.0000   20.0000  81/01/06 81/01/06
                                           TOT       20  1917.25  .159E+08  3999.77  16000.0   10.0000  77/02/20 81/03/31
 39390 ENDRIN                   TOT UG/L   K          6  .100000-.223E-08   .000000  .100000   .100000  80/05/06 80/11/21
 39400 TOXAPHEN                 TOTUG/L    K          6  5.00000  .000000   .000000  5.00000   5.00000  80/05/06 80/11/21
 39480 MTHXYCLR    WHL SMPL     UG/L       K          6  .200000 .357E-07   .000189  .200000   .200000  80/05/06 80/11/21
 39530 MALATHN     WHL SMPL     UG/L       K          6  10.0000  .000000   .000000  10.0000   10.0000  80/05/06 80/11/21
 39570 DIAZINON    WHL SMPL     UG/L       K          6  2.00000  .000000   .000000  2.00000   2.00000  80/05/06 80/11/21
 39730  2,4-D      WHL SMPL     UG/L       K          1  .100000                     .100000   .100000  80/10/08 80/10/08
 39740 2,4,5-T     WHL SMPL     UG/L       K          1  .040000                     .040000   .040000  80/10/08 80/10/08
 39760  SILVEX     WHL SMPL     UC/L       K          1  .040000                     .040000   .040000  80/10/08 80/10/08
 39782 LINDANE     WHL SMPL     UG/L       K          6  .050000 .372E-08   .000061  .050000   .050000  80/05/06 80/11/21
 71900 MERCURY     HG,TOTAL     UG/L       K          5  .500000  .000000   .000000  .500000   .500000  79/10/30 80/11/21
```

201

46

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                            208LCOG-0023    W00023        S-Q-SKP
                                                            44 03 36.0 123 04 30.0  2
                                                            Q ST CHANNEL AT SKIPWORTH JUVENILE HOME
                                                            41039 OREGON                  LANE
/CANAL/TYPA/AMBNT/RUNOFF                                    PACIFIC NORTHWEST             130900
                                                            WILLAMETTE RIVER
                                                            10EPACOP  800531
INDEX 1310001  001140  01790                                 0000  CLASS 00 CSN-RSP 0551490-0042694
MILES 0101.50 0182.30 000.40
PARAMETER                                 RMK  NUMBER    MEAN    VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00008    LAB     IDENT.      NUMBER              19   .000000   .000000   .000000   .000000   .000000  75/12/09 81/01/06
00010   WATER     TEMP        CENT               10   16.0500   26.6921   5.16644   24.5000   9.00000  76/04/20 81/01/06
00061   STREAM    FLOW,     INST-CFS       J     18   20.5000   1208.06   34.7571   150.000   2.00000  75/12/09 80/10/08
00076    TURB   TRBIDMTR    HACH FTU              7   10.8000   230.577   15.1848   44.0000   2.20000  79/12/10 81/01/06
00095 CNDUCTVY   AT 25C     MICROMHO             19   169.579   1194.49   34.5614   230.000   101.000  75/12/09 81/01/06
00300     DO                  MG/L                4   9.05000   7.17676   2.67895   11.3000   6.00000  78/07/31 80/03/10
                                           J      1   9.40000                       9.40000   9.40000  80/10/08 80/10/08
                                           TOT    5   9.11999   5.40710   2.32532   11.3000   6.00000  78/07/31 80/10/08
00310    BOD      5 DAY       MG/L                1   10.1000                       10.1000   10.1000  80/05/06 80/05/06
00315    BOD      7 DAY       MG/L               10   3.77999   8.07293   2.84129   11.1000   1.20000  76/02/09 80/03/10
                                           L      1   5.80000                       5.80000   5.80000  78/07/31 78/07/31
                                           TOT   11   3.96363   7.63659   2.76344   11.1000   1.20000  76/02/09 80/03/10

00324    BOD      20 DAY      MG/L                1   14.0000                       14.0000   14.0000  80/10/08 80/10/08
00335    COD     LOWLEVEL     MG/L               18   12.9444   54.0320   7.35065   36.0000   3.60000  75/12/09 81/01/06
00400     PH                   SU                18   7.07777   .208884   .457038   8.20000   6.50000  75/12/09 81/01/06
00410   T ALK     CACO3       MG/L               11   67.3636   301.568   17.3657   102.000   32.6000  76/02/09 81/01/06
00500  RESIDUE    TOTAL       MG/L               19   145.316   658.010   25.6517   186.000   62.0000  75/12/09 81/01/06
00530  RESIDUE   TOT NFLT     MG/L               17   12.3294   163.470   12.7855   55.0000   1.00000  76/01/05 81/01/06
00545  RESIDUE   SETTLBLE     ML/L         J      2   .030000   .000800   .028284   .050000   .010000  77/01/11 80/01/14
                                           K      3   .040000   .002700   .051961   .100000   .010000  79/12/10 81/01/06
                                           TOT    5   .036000   .001580   .039749   .100000   .010000  77/01/11 81/01/06
00556 OIL-GRSE   FREON-GR     MG/L         K      1   1.00000                       1.00000   1.00000  80/03/10 80/03/10
00610 NH3+NH4-   N TOTAL      MG/L                4   .200000   .020000   .141421   .400000   .100000  79/12/10 81/01/06
                                           K      3   .100000-.186E-08   .000000   .100000   .100000  80/03/10 80/07/08
                                           TOT    7   .157143   .012857   .113390   .400000   .100000  79/12/10 81/01/06
00615   NO2-N     TOTAL       MG/L                1   .050000                       .050000   .050000  81/01/06 81/01/06
                                           K      6   .100000-.223E-08   .000000   .100000   .100000  79/12/10 80/10/08
                                           TOT    7   .092857   .000357   .018898   .100000   .050000  79/12/10 81/01/06
00625 TOT KJEL      N         MG/L                1   .150000                       .150000   .150000  80/03/10 80/03/10
00630 NO2&NO3    N-TOTAL      MG/L               13   1.90923   1.97885   1.40672   5.40000   .080000  76/09/01 81/01/06
00665 PHOS-TOT               MG/L P              16   .135562   .006031   .077662   .377000   .070000  76/02/09 81/01/06
00680 T ORG C       C         MG/L                1   18.0000                       18.0000   18.0000  80/03/10 80/03/10
00900 TOT HARD    CACO3       MG/L               11   70.4181   340.323   18.4478   108.000   36.6000  75/12/09 81/01/06
00940 CHLORIDE    TOTAL       MG/L               11   4.00908   1.53247   1.23793   6.60000   2.15000  76/02/09 81/01/06
00945 SULFATE    SO4-TOT      MG/L                4   3.97500   4.34916   2.08546   6.80000   1.80000  79/12/10 80/07/08
00956  SILICA     TOTAL       MG/L                8   13.1875   241.227   15.5315   48.0000   2.10000  76/01/05 78/10/02
01034 CHROMIUM   CR,TOT       UG/L         J      6   .500000   .700000   .836660   2.00000   .000000  79/12/10 81/01/06
01042 COPPER     CU,TOT       UG/L                2   2.00000   .000000   .000000   2.00000   2.00000  80/10/08 81/01/06
                                           J      4   3.75000   2.91667   1.70782   6.00000   2.00000  79/12/10 80/07/08
                                           TOT    6   3.16667   2.56668   1.60209   6.00000   2.00000  79/12/10 81/01/06
01045    IRON    FE,TOT       UG/L               11   1112.91    764987   874.635   3600.00   652.000  75/12/09 81/01/06
```

No Duplicates

<MIS CODE = 335

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                    208LCOG-0023     WQ0023       S-Q-SKP
                                                   44 03 36.0 123 04 30.0  2
                                                   Q ST CHANNEL AT SKIPWORTH JUVENILE HOME
                                                   41039 OREGON                    LANE
/CANAL/TYPA/AMBNT/RUNOFF                           PACIFIC NORTHWEST               130900
                                                   WILLAMETTE RIVER
INDEX 1310001  001140  01790                       10EPACOP  800531
MILES 0101.50 0182.30 000.40                        0000  CLASS 00 CSN-RSP 0551490-0042694
PARAMETER
                                       RMK  NUMBER     MEAN   VARIANCE  STAN DEV   MAXIMUM   MINIMUM  BEG DATE END DATE
01051 LEAD        PB,TOT       UG/L              6  8.31667   31.7617   5.63575   15.0000   .000000 79/12/10 81/01/06
01067  NICKEL     NI,TOTAL     UG/L     K        5  100.000   .000000   .000000   100.000   100.000 79/12/10 80/10/08
01092 ZINC        ZN,TOT       UG/L              3  23.6667   842.334   29.0230   57.0000   4.00000 80/01/14 81/01/06
                                        J        3  13.3333   57.3335   7.57189   22.0000   8.00000 79/12/10 80/10/08
31616 FEC COLI    MFM-FCBR     /100ML   TOT      6  18.5000   391.900   19.7965   57.0000   4.00000 79/12/10 81/01/06
                                                15  203.933    133487   365.358   1400.00   20.0000 75/12/09 81/01/06
                                        K        4  13.5000   62.3333   7.89515   20.0000   4.00000 76/02/09 78/07/12
71900 MERCURY     HG,TOTAL     UG/L     TOT     19  163.842    110196   331.957   1400.00   4.00000 75/12/09 81/01/06
                                        K        2  .500000   .000000   .000000   .500000   .500000 79/12/10 80/10/08
```

206

1 Duplicate

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                              20BLCOG-0024     WQ0024        S-Q-GW        FLOW0024
                                                              44 03 36.0 123 03 01.0  2
                                                              Q STREET CHANNEL AT GARDEN WAY, SPRINGFIELD
                                                              41039 OREGON                  LANE
/CANAL/TYPA/AMBNT/RUNOFF                                      PACIFIC NORTHWEST             130900
                                                              WILLAMETTE RIVER
INDEX 1310001  001140  01790                                  10FPACOP  800531
MILES 0101.50 0182.30 001.80                                   0000  CLASS 00 CSN-RSP 0551491-0042696
PARAMETER
00008   LAB      IDENT.     NUMHER      RMK  NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM   MINIMUM  BEG DATE END DATE
00010  WATER      TEMP       CENT              22   .000000   .000000  .000000  .000000   .000000 79/12/10 81/03/31
                                               21   15.3571   22.0539  4.69616  25.0000   9.50000 79/12/10 81/03/31
                                        J       4   13.0000   1.33333  1.15470  14.0000   12.0000 80/11/21 81/03/31
00061  STREAM     FLOW,     INST-CFS    TOT    25   14.9800   19.3227  4.39577  25.0000   9.50000 79/12/10 81/03/31
                                               21   31.3333   1206.15  34.7296  150.000   3.60000 79/12/10 81/03/31
                                        J       4   20.0000   546.000  23.3666  55.0000   7.00000 80/02/11 80/11/21
00076   TURB    TRBIDMTR    HACH FTU    TOT    25   29.5200   1091.35  33.0357  150.000   3.60000 79/12/10 81/03/31
00095 CNDUCTVY   AT 25C     MICROMHO           25   16.0480   477.739  21.8572  80.0000   2.30000 79/12/10 81/03/31
00300    DO                   MG/L             25   144.040   1480.71  38.4800  213.000   56.0000 79/12/10 81/03/31
00315   BOD       7 DAY       MG/L             18   7.96999   3.10560  1.76227  11.1000   4.50000 80/01/14 81/03/31
00324   BOD      20 DAY       MG/L              3   5.78666   10.8707  3.29707  9.26000   2.70000 80/01/14 80/03/10
                                               12   15.6083   90.7208  9.52474  41.3000   3.20000 80/05/06 81/03/31
                                        L       4   27.7250   274.103  16.5560  42.0000   7.10000 80/05/09 81/03/31
00335   COD     LOWLEVEL      MG/L      TOT    16   18.6375   150.712  12.2765  42.0000   3.20000 80/05/06 81/03/31
00400    PH                    SU              24   28.2833   473.213  21.7535  82.2000   6.80000 79/12/10 81/03/31
00410  T ALK      CACO3       MG/L             25   7.04799   .128408  .358340  8.00000   6.60000 79/12/10 81/03/31
00500 RESIDUE     TOTAL       MG/L             25   56.3519   276.732  16.6352  86.1000   17.4000 79/12/10 81/03/31
00530 RESIDUE    TOT NFLT     MG/L             25   138.000   524.750  22.9074  191.000   106.000 79/12/10 81/03/31
00545 RESIDUE    SETTLBLE     ML/L             20   18.5000   486.052  22.0466  86.0000   1.00000 79/12/10 81/03/31
                                                3   .126667   .023433  .153079  .300000   .010000 80/09/02 80/11/21
                                        J       3   .006667   .000033  .005774  .010000   .000000 80/01/14 81/03/31
                                        K      10   .028000   .001440  .037947  .100000   .010000 79/12/10 81/03/31
00556 OIL-GRSE   FREON-GR     MG/L      TOT    16   .042500   .005807  .076201  .300000   .000000 79/12/10 81/03/31
                                                3   2.20000   .610003  .781027  3.10000   1.70000 80/05/09 80/09/02
                                        K       4   1.00000   .000000  .000000  1.00000   1.00000 80/03/10 80/11/21
00610 NH3+NH4-   N TOTAL      MG/L      TOT     7   1.51428   .614764  .784069  3.10000   1.00000 80/03/10 80/11/21
                                               15   .449333   .207078  .455058  1.60000   .100000 79/12/10 81/03/31
                                        J       1   .100000                     .100000   .100000 80/05/09 80/05/09
                                        K       9   .100000   .000000  .000000  .100000   .100000 80/03/10 81/03/31
00615  NO2-N      TOTAL       MG/L      TOT    25   .309600   .151304  .388978  1.60000   .100000 79/12/10 81/03/31
                                               12   .085000   .001482  .038494  .160000   .030000 80/05/09 81/03/31
                                        J       1   .100000                     .100000   .100000 80/05/09 80/05/09
                                        K       8   .100000   .000000  .000000  .100000   .100000 79/12/10 80/08/04
00625 TOT KJEL      N         MG/L      TOT    21   .091428   .000873  .029544  .160000   .030000 79/12/10 81/03/31
                                                3   .076667   .005433  .073711  .160000   .020000 80/03/10 80/10/08
                                        K       5   .014000   .000030  .005477  .020000   .010000 80/09/02 81/01/06
00630 NO2&NO3    N-TOTAL      MG/L      TOT     8   .037500   .002621  .051200  .160000   .010000 80/03/10 81/01/06
00665 PHOS-TOT               MG/L P            25   1.10840   .332258  .576418  2.20000   .260000 79/12/10 81/03/31
00680 T ORG C       C         MG/L             25   .191880   .007903  .088901  .460000   .101000 79/12/10 81/03/31
00900 TOT HARD    CACO3       MG/L              9   16.9889   47.6165  6.90047  23.5000   4.20000 80/03/10 81/01/06
                                               22   56.3545   220.170  14.8381  78.3000   20.8000 79/12/10 81/03/31
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                            208LCOG-0024    W00024       8-Q-GW       FLOW0024
                                                           44 03 36.0 123 03 01.0  2
                                                           Q STREET CHANNEL AT GARDEN WAY, SPRINGFIELD
                                                           41039 OREGON                 LANE
                                                           PACIFIC NORTHWEST            130900
/CANAL/TYPA/AMBNT/RUNOFF                                   WILLAMETTE RIVER
                                                           10EPACOP  800531
INDEX 1310001  001140  01790                                0000  CLASS 00 CSN-RSP 0551491-0042696
MILES 0101.50 0182.30 001.80
PARAMETER
00940 CHLORIDE      TOTAL      MG/L       RMK  NUMBER    MEAN    VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00945 SULFATE      SO4-TOT     MG/L               23   3.68043   1.74699  1.32174   6.50000   1.10000 79/12/10 81/03/31
01002 ARSENIC      AS,TOT      UG/L                7   3.80000   2.27003  1.50666   5.80000   1.00000 79/12/10 80/07/08
01034 CHROMIUM     CR,TOT      UG/L        J       5   1.60000   1.30000  1.14018   3.00000   .000000 80/02/11 80/11/21
                                                   3   4.00000   9.00000  3.00000   7.00000   1.00000 80/09/02 80/11/21
                                           J      17   1.00000   .875000  .935414   3.00000   .000000 79/12/10 81/03/31
01042 COPPER       CU,TOT      UG/L        TOT    20   1.45000   2.89211  1.70062   7.00000   .000000 79/12/10 81/03/31
                                                  12   10.9167   59.3561  7.70429   31.0000   2.00000 80/01/14 81/03/31
                                           J       8   3.25000   7.35714  2.71240   8.00000   1.00000 79/12/10 81/03/17
01045   IRON       FE,TOT      UG/L        TOT    20   7.85000   51.9237  7.20581   31.0000   1.00000 79/12/10 81/03/31
                                                  20   1235.00   1766677  1329.16   4900.00   220.000 79/12/10 81/03/31
                                           J       1   80.0000                      80.0000   80.0000 81/03/17 81/03/17
01051 LEAD         PB,TOT      UG/L        TOT    21   1180.00   1741868  1319.80   4900.00   80.0000 79/12/10 81/03/31
                                                  17   27.1294   762.111  27.6063   118.000   4.00000 80/01/14 81/03/31
                                           J       4   4.75000   6.91667  2.62996   7.00000   2.00000 79/12/10 81/03/17
01067  NICKEL      NI,TOTAL    UG/L        TOT    21   22.8666   691.814  26.3023   118.000   2.00000 79/12/10 81/03/31
01092 ZINC         ZN,TOT      UG/L        K      12   100.000   .000000  .000000   100.000   100.000 79/12/10 80/10/08
                                                  11   37.0000   755.400  27.4845   100.000   10.0000 80/01/14 81/03/31
                                           J       9   13.7778   102.194  10.1091   30.0000   1.00000 79/12/10 81/03/17
31616 FEC COLI     MFM-FCBR    /100ML      TOT    20   26.5500   581.103  24.1061   100.000   1.00000 79/12/10 81/03/31
39390 ENDRIN                   TOT UG/L           20   1683.00  .106E+08  3266.62   13200.0   10.0000 79/12/10 81/03/31
39400 TOXAPHEN                 TOTUG/L     K       1   .100000                      .100000   .100000 80/10/08 80/10/08
39480 MTHXYCLR     WHL SMPL    UG/L        K       1   5.00000                      5.00000   5.00000 80/10/08 80/10/08
39530 MALATHN      WHL SMPL    UG/L        K       1   .200000                      .200000   .200000 80/10/08 80/10/08
39570 DIAZINON     WHL SMPL    UG/L        K       1   10.0000                      10.0000   10.0000 80/10/08 80/10/08
39730  2,4-D       WHL SMPL    UG/L        K       1   2.00000                      2.00000   2.00000 80/10/08 80/10/08
                                                   2   1.60000   1.62000  1.27279   2.50000   .700000 80/09/02 80/09/02
                                           K       3   .100000-.186E-08   .000000   .100000   .100000 80/06/11 80/11/21
39740 2,4,5-T      WHL SMPL    UG/L        TOT     5   .700000   1.08000  1.03923   2.50000   .100000 80/06/11 80/11/21
39760  SILVEX      WHL SMPL    UG/L        K       5   .040000  .186E-08  .000043   .040000   .040000 80/06/11 80/11/21
39782 LINDANE      WHL SMPL    UG/L        K       5   .040000  .186E-08  .000043   .040000   .040000 80/06/11 80/11/21
71900 MERCURY      HG,TOTAL    UG/L        K       1   .050000                      .050000   .050000 80/10/08 80/10/08
                                           J       1   .500000                      .500000   .500000 80/11/21 80/11/21
                                           K       3   .500000   .000000  .000000   .500000   .500000 79/12/10 80/11/21
                                           TOT     4   .500000   .000000  .000000   .500000   .500000 79/12/10 80/11/21
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                              208LCOG-0032      WQ0032        8-Q-QN
                                                              44 03 45.0 123 02 20.0  2
                                                              Q STREET CHANNEL AT QUINALT
                                                              41039 OREGON                LANE
 /CANAL/TYPA/AMBNT/RUNOFF                                     PACIFIC NORTHWEST           130900
                                                              WILLAMETTE RIVER
 INDEX 1310001  001140  01790                                 10EPACOP  810228
 MILES 0101.50 0182.30 002.40                                  0000  CLASS 00 CSN-RSP 0582222-0042709
 PARAMETER
                                          RMK  NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM  MINIMUM  BEG DATE END DATE
 00008   LAB       IDENT.     NUMBER              31  .000000  .000000  .000000  .000000  .000000 76/04/20 78/10/02
 00010  WATER      TEMP       CENT                 3  22.3333  37.3337  6.11013  29.0000  17.0000 76/04/20 78/10/02
 00061  STREAM     FLOW,      INST-CFS            20  11.6550  188.812  13.7409  60.0000  .500000 76/09/27 77/01/11
                                           J      11  13.6364  850.654  29.1660  100.000  .500000 76/04/20 78/10/02
                                           TOT    31  12.3581  404.061  20.1013  100.000  .500000 76/04/20 78/10/02
 00095 CNDUCTVY    AT 25C     MICROMHO            28  113.536  1177.08  34.3085  190.000  54.0000 76/04/20 78/10/02
 00300    DO                  MG/L                 3  8.39999  1.00013  1.00006  9.40000  7.40000 78/07/12 78/10/02
 00315    BOD      7 DAY      MG/L                24  7.50833  55.5191  7.45111  35.0000  1.10000 76/04/20 78/10/02
                                           K       2  5.50000  40.5000  6.36396  10.0000  1.00000 76/10/24 76/11/17
                                           L       2  8.80000  .320129  .565800  9.20000  8.40000 77/01/11 78/07/31
                                           TOT    28  7.45714  49.2255  7.01609  35.0000  1.00000 76/04/20 78/10/02
 00335    COD      LOWLEVEL   MG/L                27  44.9111  1564.03  39.5478  150.000  5.50000 76/04/20 78/07/31
 00340    COD      HI LEVEL   MG/L                 1  25.0000                    25.0000  25.0000 78/10/02 78/10/02
 00400    PH                  SU                  29  7.44827  .339015  .582250  9.00000  6.80000 76/04/20 78/07/31
 00500 RESIDUE     TOTAL      MG/L                27  180.518  11268.1  106.151  528.000  62.0000 76/04/20 78/10/02
 00530 RESIDUE     TOT NFLT   MG/L                31  73.6129  12913.4  113.637  523.000  1.00000 76/04/20 78/10/02
 00545 RESIDUE     SETTLBLE   ML/L                 7  3.39142  42.0643  6.48570  18.0000  .020000 76/10/24 77/02/21
                                           J       1  .010000                    .010000  .010000 77/01/11 77/01/11
                                           TOT     8  2.96874  37.4844  6.12245  18.0000  .010000 76/10/24 77/02/21
 00630 NO2&NO3     N-TOTAL    MG/L                26  .530307  .718022  .847362  4.30000  .008000 76/08/14 78/10/02
                                           J       2  .370000  .009800  .098995  .440000  .300000 77/01/11 77/02/21
                                           TOT    28  .518857  .666966  .816680  4.30000  .008000 76/08/14 78/10/02
 00650  T PO4      PO4        MG/L                 1  .238000                    .238000  .238000 78/10/02 78/10/02
 00665 PHOS-TOT               MG/L P              29  .304931  .052807  .229798  1.06000  .079000 76/04/20 78/07/31
 00940 CHLORIDE    TOTAL      MG/L                 2  3.25000  .404999  .636395  3.70000  2.80000 76/04/20 76/10/24
 00956  SILICA     TOTAL      MG/L                24  48.0166  2418.94  49.1827  174.000  2.00000 76/08/14 78/10/02
 01045   IRON      FE,TOT     UG/L                 1  435.000                    435.000  435.000 76/09/01 76/09/01
 31616 FEC COLI    MFM-FCBR   /100ML              18  1294.94  2489951  1577.96  6000.00  14.0000 76/04/20 78/10/02
                                           K       7  50.0000  2200.00  46.9042  100.000  10.0000 76/09/27 78/07/31
                                           TOT    25  946.360  2089740  1445.59  6000.00  10.0000 76/04/20 78/10/02
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                             20BLCOG-0025       WQ0025          S-Q-2          FLOW0025
                                                             44 03 38.0 123 01 33.0  2
                                                             Q STREET CHANNEL AT SECOND STREET, SPRINGFIELD
                                                             41039 OREGON                       LANE
 /CANAL/TYPA/AMBNT/RUNOFF                                    PACIFIC NORTHWEST                  130900
                                                             WILLAMETTE RIVER
                                                             10EPACOP  800531
 INDEX 1310001   001140  01790                                0000  CLASS 00 CSN-PSP 0551492-0042698
 MILES 0101.50 0182.30 003.20
 PARAMETER                                  RMK  NUMBER   MEAN    VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
 00008   LAB      IDENT.     NUMBER               31   .000000   .000000   .000000   .000000   .000000 76/04/20 81/03/31
 00010  WATER      TEMP       CENT                30   16.0833   28.5017   5.33870   28.0000   9.00000 76/04/20 81/03/31
                                             J     1   14.0000                       14.0000   14.0000 81/03/31 81/03/31
                                            TOT   31   16.0161   27.6915   5.26227   28.0000   9.00000 76/04/20 81/03/31
 00061  STREAM     FLOW,    INST-CFS              18   18.9889   307.698   17.5413   70.0000   3.60000 80/03/10 81/03/31
                                             J    16   14.2062   568.027   23.8333   100.000   1.80000 76/04/20 81/03/17
                                            TOT   34   16.7382   422.577   20.5567   100.000   1.80000 76/04/20 81/03/31
 00076   TURB     TRBIDMTR   HACH FTU             28   26.0678   1181.53   34.3733   120.000   1.40000 79/10/30 81/03/31
 00095 CNDUCTVY    AT 25C    MICROMHO             34   140.971   1235.68   35.1523   228.000   61.0000 76/04/20 81/03/31
 00300    DO                   MG/L               22   8.69727   6.29219   2.50842   13.1000   3.80000 78/07/12 81/03/31
 00315   BOD       7 DAY       MG/L                7   5.57142   6.32911   2.51577   8.30000   1.40000 77/01/11 80/03/10
                                             L     2   8.67000   .273849   .523306   9.04000   8.30000 78/10/02 80/01/14
                                            TOT    9   6.26000   6.64795   2.57836   9.04000   1.40000 77/01/11 80/03/10
 00324   BOD      20 DAY       MG/L               11   18.4545   70.7886   8.41360   36.8000   7.00000 80/05/09 81/03/31
                                             L     4   11.0500   48.2699   6.94766   21.3000   6.60000 80/05/06 81/03/31
                                            TOT   15   16.4800   72.3946   8.50850   36.8000   6.60000 80/05/06 81/03/31
 00335   COD     LOWLEVEL      MG/L               32   37.2874   788.045   28.0721   98.8000   6.60000 76/04/20 81/03/31
 00400    PH                    SU                33   7.27272   .307655   .554667   8.80000   6.60000 76/04/20 81/03/31
 00410  T ALK      CACO3       MG/L               28   52.4678   237.762   15.4195   84.9000   20.9000 79/10/30 81/03/31
 00500 RESIDUE     TOTAL       MG/L               32   157.437   3246.90   56.9816   275.000   97.0000 76/04/20 81/03/31
 00530 RESIDUE   TOT NFLT      MG/L               28   29.6071   2272.47   47.6704   175.000   1.00000 76/04/20 81/03/31
                                             K     1   1.00000                       1.00000   1.00000 78/07/12 78/07/12
                                            TOT   29   28.6207   2219.53   47.1119   175.000   1.00000 76/04/20 81/03/31
 00545 RESIDUE   SETTLBLE      ML/L                7   .361428   .119081   .345081   1.00000   .050000 80/09/02 81/03/31
                                             J     2   .010000-.145E-10   .000000   .010000   .010000 77/01/11 80/01/14
                                             K    10   .019000   .000810   .028460   .100000   .010000 79/12/10 81/03/31
                                            TOT   19   .144210   .069159   .262981   1.00000   .010000 77/01/11 81/03/31
 00556 OIL-GRSE  FREON-GR      MG/L                7   1.87857   .341548   .584421   2.80000   1.20000 80/05/09 80/11/21
                                             K     2   1.00000   .000000   .000000   1.00000   1.00000 80/03/10 80/09/02
                                            TOT    9   1.68333   .406250   .637377   2.80000   1.00000 80/03/10 80/11/21
 00610 NH3+NH4-   N TOTAL      MG/L               23   .471739   .519867   .721018   3.60000   .100000 79/10/30 81/03/31
                                             K     5   .100000-.279E-08   .000000   .100000   .100000 80/03/10 80/10/08
                                            TOT   28   .405357   .444616   .666795   3.60000   .100000 79/10/30 81/03/31
 00615  NO2-N      TOTAL       MG/L               12   .094166   .002608   .051072   .240000   .050000 80/05/09 81/03/31
                                             J     1   .060000                       .060000   .060000 81/03/17 81/03/17
                                             K    10   .100000   .000000   .000000   .100000   .100000 79/12/10 81/01/06
                                            TOT   23   .095217   .001372   .037035   .240000   .050000 79/12/10 81/03/31
 00625 TOT KJEL      N         MG/L                2   .095000   .006050   .077782   .150000   .040000 80/03/10 80/11/04
                                             K     6   .015000   .000030   .005477   .020000   .010000 80/09/02 81/01/06
                                            TOT    8   .035000   .002257   .047509   .150000   .010000 80/03/10 81/01/06
 00630 NO2&NO3    N-TOTAL      MG/L               31   .804514   .210000   .458257   2.60000   .160000 77/01/11 81/03/31
```

3 Duplicates

210

49

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                          208LCOG-0025       WQ0025        S-Q-2          FLOW0025
                                                          44 03 38.0 123 01 33.0  2
                                                          Q STREET CHANNEL AT SECOND STREET, SPRINGFIELD
                                                          41039 OREGON                  LANE
                                                          PACIFIC NORTHWEST             130900
/CANAL/TYPA/AMBNT/RUNOFF                                  WILLAMETTE RIVER
                                                          10EPACOP  800531
INDEX 1310001  001140  01790                              0000  CLASS 00 CSN-RSP 0551492-0042698
MILES 0101.50 0182.30 003.20
PARAMETER
                                           RMK  NUMBER    MEAN  VARIANCE STAN DEV  MAXIMUM  MINIMUM  BEG DATE END DATE
00630 NO2&NO3     N-TOTAL      MG/L        J       1   .200000
                                           TOT                                     .200000  .200000 77/01/11 77/01/11
00665 PHOS-TOT                 MG/L P             32   .785623   .214645  .463298  2.60000  .160000 77/01/11 81/03/31
00680 T ORG C        C         MG/L               33   .231788   .017958  .134009  .580000  .017000 76/04/20 81/03/31
00900 TOT HARD     CACO3       MG/L               10   15.0400   57.2983  7.56956  26.0000  2.90000 80/03/10 81/01/06
00940 CHLORIDE     TOTAL       MG/L               26   50.2884   152.600  12.3531  78.5000  22.2000 79/10/30 81/03/31
00945 SULFATE     SO4-TOT      MG/L               28   3.59285   2.63422  1.62303  9.20000  1.55000 76/04/20 81/03/31
00956  SILICA      TOTAL       MG/L                6   3.70000   1.50802  1.22801  5.10000  2.00000 79/10/30 80/07/08
01002 ARSENIC     AS,TOT       UG/L                5   33.2600   3447.96  58.7193  138.000  3.00000 77/01/11 78/10/02
01034 CHROMIUM    CR,TOT       UG/L        J       5   2.20000   1.70000  1.30384  4.00000  1.00000 80/02/11 80/11/21
                                                   6   2.50000   10.3000  3.20936  9.00000  1.00000 80/09/02 80/11/21
                                           J      19   1.52632   4.59649  2.14394  7.00000  .000000 79/10/30 81/03/31
01042 COPPER      CU,TOT       UG/L        TOT    25   1.76000   5.77334  2.40278  9.00000  .000000 79/10/30 81/03/31
                                                  12   17.3333   144.788  12.0328  41.0000  2.00000 80/01/14 81/03/31
                                           J      13   2.69231   3.73077  1.93152  6.00000  .000000 79/10/30 81/03/17
01045   IRON      FE,TOT       UG/L        TOT    25   9.72000   123.960  11.1337  41.0000  .000000 79/10/30 81/03/31
                                                  25   1423.60   2835198  1683.80  6400.00  100.000 79/10/30 81/03/31
                                           J       1   10.0000
                                           TOT                                     10.0000  10.0000 80/07/08 80/07/08
01051 LEAD        PB,TOT       UG/L               26   1369.23   2798646  1672.92  6400.00  10.0000 79/10/30 81/03/31
                                                  16   41.1812   2112.64  45.9634  191.000  2.00000 79/10/30 81/03/31
                                           J      10   2.70000   6.23334  2.49666  8.00000  .000000 79/12/10 81/03/17
01067  NICKEL     NI,TOTAL     UG/L        TOT    26   26.3807   1634.33  40.4269  191.000  .000000 79/10/30 81/03/31
01092 ZINC        ZN,TOT       UG/L        K      17   100.000   .000000  .000000  100.000  100.000 79/10/30 80/10/08
                                                  13   54.8461   1149.14  33.8990  143.000  4.00000 79/10/30 81/03/31
                                           J      12   9.50000   60.0909  7.75183  30.0000  1.00000 79/12/10 81/03/17
31616 FEC COLI    MFM-FCBR     /100ML      TOT    25   33.0800   1136.74  33.7156  143.000  1.00000 79/10/30 81/03/31
                                                  28   8309.10  .403E+09  20088.2  74000.0  10.0000 77/01/11 81/03/31
                                           K       2   15.0000   50.0000  7.07107  20.0000  10.0000 76/04/20 80/11/04
39390 ENDRIN                   TOT UG/L    TOT    30   7756.16  .380E+09  19497.0  74000.0  10.0000 76/04/20 81/03/31
39400 TOXAPHEN                 TOTUG/L     K       2   .100000-.372E-08  .000000  .100000  .100000 80/05/06 80/11/21
39480 MTHXYCLR    WHL SMPL     UG/L        K       2   5.00000   .000000  .000000  5.00000  5.00000 80/05/06 80/11/21
39530 MALATHN     WHL SMPL     UG/L        K       2   .200000   .000000  .000000  .200000  .200000 80/05/06 80/11/21
39570 DIAZINON    WHL SMPL     UG/L        K       2   10.0000   .000000  .000000  10.0000  10.0000 80/05/06 80/11/21
39730  2,4-D      WHL SMPL     UG/L        K       2   2.00000   .000000  .000000  2.00000  2.00000 80/05/06 80/11/21
                                                   2   .265000   .036450  .190919  .400000  .130000 80/09/02 80/09/02
                                           K       2   .100000-.372E-08  .000000  .100000  .100000 80/06/11 80/11/21
39740 2,4,5-T     WHL SMPL     UG/L        TOT     4   .182500   .021225  .145688  .400000  .100000 80/06/11 80/11/21
                                                   2   .110000   .000200  .014142  .120000  .100000 80/09/02 80/09/02
                                           K       2   .040000  .116E-08  .000034  .040000  .040000 80/06/11 80/11/21
39760  SILVEX     WHL SMPL     UG/L        TOT     4   .075000   .001700  .041231  .120000  .040000 80/06/11 80/11/21
                                                   2   .025000   .000050  .007071  .030000  .020000 80/09/02 80/09/02
                                           K       2   .040000  .116E-08  .000034  .040000  .040000 80/06/11 80/11/21
```

211

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                          208LCOG-0025       WQ0025        S-Q-2        FLOW0025
                                                          44 03 38.0 123 01 33.0  2
                                                          Q STREET CHANNEL AT SECOND STREET, SPRINGFIELD
                                                          41039 OREGON                 LANE
                                                          PACIFIC NORTHWEST            130900
/CANAL/TYPA/AMBNT/RUNOFF                                  WILLAMETTE RIVER
                                                          10EPACOP  800531
INDEX 1310001  021140  01790                               0000  CLASS 00 CSN-RSP 0551492-0042698
MILES 0101.50 0182.30 003.20
PARAMETER                               RMK   NUMBER    MEAN  VARIANCE STAN DEV MAXIMUM   MINIMUM  BEG DATE END DATE
39760  SILVEX     WHL SMPL     UG/L     TOT        4 .032500  .000092  .009574  .040000  .020000 80/06/11 80/11/21
39782 LINDANE     WHL SMPL     UG/L     K          2 .050000 .372E-08  .000061  .050000  .050000 80/05/06 80/11/21
71900 MERCURY     HG,TOTAL     UG/L                1 .500000                    .500000  .500000 80/10/08 80/10/08
                                        K          4 .500000  .000000  .000000  .500000  .500000 79/10/30 80/11/21
                                        TOT        5 .500000  .000000  .000000  .500000  .500000 79/10/30 80/11/21
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                              208LCOG-0026     WQ0026         S-Q-NB         FLOW0026
                                                             44 03 48.0 122 59 43.0  2
                                                             N BRANCH Q ST CHANNEL AT MOHAWK BLVD
                                                             41039 OREGON                  LANE
/CANAL/TYPA/AMBNT/RUNOFF                                     PACIFIC NORTHWEST             130900
                                                             WILLAMETTE RIVER
 INDEX 1310001  001140  01790  0110                          10EPACOP  800531
 MILES 0101.50 0182.30 004.40 000.30                          0000  CLASS 00 CSN-RSP 0551493-0042701
 PARAMETER
 00008   LAB        IDENT.      NUMBER      RMK   NUMBER   MEAN     VARIANCE STAN DEV MAXIMUM   MINIMUM  BEG DATE END DATE
 00010  WATER        TEMP        CENT                12  .000000   .000000  .000000  .000000  .000000 76/04/20 81/01/06
 00061  STREAM       FLOW,     INST-CFS              11  15.4545   20.6728  4.54673  21.0000  9.00000 76/04/20 81/01/06
                                                      3  3.03333   1.26334  1.12398  4.00000  1.80000 80/03/10 81/01/06
                                                J     9  5.50000   36.0625  6.00521  20.0000  1.00000 76/04/20 80/07/08
 00076   TURB      TRBIDMTR    HACH FTU         TOT  12  4.88333   27.7015  5.26322  20.0000  1.00000 76/04/20 81/01/06
 00095 CNDUCTVY     AT 25C     MICROMHO              10  5.35199   140.382  11.8483  39.0000  .720000 79/10/30 81/01/06
 00300    DO                     MG/L                12  107.333   1341.89  36.6318  211.000  77.0000 76/04/20 81/01/06
 00315   BOD        7 DAY        MG/L                 8  7.83749   1.10557  1.05146  9.70000  6.60000 80/01/14 81/01/06
 00324   BOD        20 DAY       MG/L                 4  3.83000   8.96226  2.99370  8.20000  1.70000 76/04/20 80/03/10
 00335   COD       LOWLEVEL      MG/L                 6  4.25000   11.6030  3.40632  10.6000  .500000 80/05/06 81/01/06
 00400    PH                      SU                 11  9.96363   73.2205  8.55690  30.0000  2.80000 76/04/20 81/01/06
 00410  T ALK       CACO3        MG/L                12  6.94999   .106401  .326192  7.50000  6.40000 76/04/20 81/01/06
 00500 RESIDUE      TOTAL        MG/L                10  35.2700   38.0464  6.16818  44.5000  24.1000 79/10/30 81/01/06
 00530 RESIDUE     TOT NFLT      MG/L                11  86.8182   583.569  24.1572  140.000  60.0000 76/04/20 81/01/06
 00545 RESIDUE     SETTLBLE      ML/L                 9  5.97778   31.4545  5.60843  16.0000  1.00000 76/04/20 80/07/08
                                                J     1  .010000                      .010000  .010000 80/01/14 80/01/14
                                                K     3  .040000   .002700  .051961  .100000  .010000 79/12/10 81/01/06
 00556 OIL-GRSE    FREON-GR                     TOT   4  .032500   .002025  .045000  .100000  .010000 79/12/10 81/01/06
 00610 NH3+NH4-    N TOTAL       MG/L           K     1  1.00000                      1.00000  1.00000 80/03/10 80/03/10
 00615  NO2-N       TOTAL        MG/L           K    10  .100000   .000000  .000000  .100000  .100000 79/10/30 81/01/06
 00625 TOT KJEL       N          MG/L           K     9  .090000   .000900  .030000  .100000  .010000 79/12/10 81/01/06
 00630 NO2&NO3     N-TOTAL       MG/L                 1  .060000                      .060000  .060000 80/03/10 80/03/10
                                                      7  .447142   .184124  .429097  1.10000  .030000 77/01/11 81/01/06
                                                K     3  .100000-.186E-08   .000000  .100000  .100000 80/05/06 80/10/08
 00665 PHOS-TOT                  MG/L P         TOT  10  .343000   .150868  .388417  1.10000  .030000 77/01/11 81/01/06
 00680 T URG C        C          MG/L                11  .056091   .001342  .036629  .155000  .027000 76/04/20 81/01/06
 00900 TOT HARD     CACO3        MG/L                 1  7.20000                      7.20000  7.20000 80/03/10 80/03/10
 00940 CHLORIDE     TOTAL        MG/L                 9  32.6222   13.5620  3.68266  37.2000  28.3000 79/10/30 81/01/06
 00945 SULFATE     SO4-TOT       MG/L                10  2.12000   .252348  .502343  2.80000  1.40000 76/04/20 81/01/06
 00956  SILICA      TOTAL        MG/L                 7  3.74285   2.03957  1.42813  5.80000  1.60000 79/10/30 80/07/08
 01034 CHROMIUM    CR,TOT        UG/L                 1  4.60000                      4.60000  4.60000 77/01/11 77/01/11
 01042 COPPER      CU,TOT        UG/L           J     9  .222222   .194444  .440958  1.00000  .000000 79/10/30 81/01/06
                                                      2  1.00000   .000000  .000000  1.00000  1.00000 80/10/08 81/01/06
                                                J     7  1.42857   .952383  .975901  3.00000  .000000 79/10/30 80/07/08
 01045   IRON      FE,TOT        UG/L           TOT   9  1.33333   .750001  .866026  3.00000  .000000 79/10/30 81/01/06
                                                      7  681.286    832882  912.624  2700.00  200.000 79/10/30 81/01/06
                                                J     1  .000000                      .000000  .000000 80/07/08 80/07/08
 01051 LEAD        PB,TOT        UG/L           TOT   8  596.125    771917  878.588  2700.00  .000000 79/10/30 81/01/06
                                                      1  1.00000                      1.00000  1.00000 80/10/08 80/10/08
                                                J     8  1.25000   1.07143  1.03510  3.00000  .000000 79/10/30 81/01/06
                                                TOT   9  1.22222   .944447  .971827  3.00000  .000000 79/10/30 81/01/06
```

No Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                          208LCOG-0026      WQ0026
                                                         44 03 48.0 122 59 43.0  2        S-Q-NB         FLOW0026
                                                         N BRANCH Q ST CHANNEL AT MOHAWK BLVD
                                                         41039 OREGON                  LANE
/CANAL/TYPA/AMBNT/RUNOFF                                 PACIFIC NORTHWEST             130900
                                                         WILLAMETTE RIVER
INDEX 1310001  001140  01790  0110                       10EPACUP  800531
MILES 0101.50 0182.30 004.40 000.30                       0000  CLASS 00 CSN-RSP 0551493-0042701
PARAMETER                                   RMK  NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM   MINIMUM  BEG DATE END DATE
01067  NICKEL     NI,TOTAL      UG/L        K         7  100.000  .000000  .000000  100.000   100.000  79/10/30 80/10/08
01092 ZINC        ZN,TOT        UG/L                  1  .000000                    .000000   .000000  81/01/06 81/01/06
                                            J         7  8.85714  126.476  11.2462  27.0000   .000000  79/10/30 80/10/08
31616 FEC COLI    MFM-FCBR      /100ML      TOT       8  7.75000  118.214  10.8726  27.0000   .000000  79/10/30 81/01/06
                                                      5  73.0000  920.000  30.3315  110.000   30.0000  80/01/14 80/10/08
                                            K         4  15.0000  33.3333  5.77350  20.0000   10.0000  76/04/20 80/03/10
71900 MERCURY     HG,TOTAL      UG/L        TOT       9  47.2222  1406.95  37.5093  110.000   10.0000  76/04/20 80/10/08
                                            K         3  .500000  .000000  .000000  .500000   .500000  79/10/30 80/10/08
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                              208LCOG-0030    WQ0030        S-Q-NBMAR1
                                              44 03 52.0 122 59 01.0  2
                                              MARCOLA RD DITCH BLW BMP NEAR 28TH STREET
                                              41039 OREGON                  LANE
                                              PACIFIC NORTHWEST             130900
/CANAL/TYPA/AMBNT/RUNOFF                      WILLAMETTE RIVER
                                              10EPACOP  810228
INDEX 1310001  001140  01790  0110   0020      0000  CLASS 00 CSN-RSP 0582220-0042707
MILES 0101.50 0182.30 004.40 000.40 000.54
PARAMETER
00008   LAB      IDENT,    NUMBER   RMK   NUMBER    MEAN   VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00010  WATER      TEMP      CENT             4   .000000   .000000   .000000   .000000   .000000 81/03/17 81/03/31
00095 CNDUCTVY   AT 25C   MICROMHO           2   9.75000   10.1250   3.18198   12.0000   7.50000 80/11/21 81/01/21
00335   COD     LOWLEVEL    MG/L            12   141.250   4853.84   69.6695   302.000   67.0000 80/11/21 81/03/31
00400   PH                  SU               9   622.889    183246   428.072   1430.00   237.000 80/11/21 81/03/31
00410  T ALK     CACO3      MG/L            10   6.66999   .006809   .082516   6.80000   6.60000 81/01/06 81/03/31
00500 RESIDUE    TOTAL      MG/L             1   114.400                       114.400   114.400 81/03/17 81/03/17
00545 RESIDUE   SETTLBLE    ML/L            10   1429.40   1517164   1231.73   4099.00   352.000 80/11/21 81/03/31
                                             7   5.13714   75.4189   8.68441   21.0000   .100000 80/11/21 81/03/31
                                    K        1   .040000                       .040000   .040000 81/03/31 81/03/31
00556 OIL-GRSE  FREON-GR    MG/L    TOT      8   4.49999   67.8924   8.23968   21.0000   .040000 80/11/21 81/03/31
00615  NO2-N     TOTAL      MG/L            13   27.7461   801.035   28.3026   92.0000   3.00000 80/11/21 81/03/31
00630 NO2&NO3   N-TOTAL     MG/L    K        1   .010000                       .010000   .010000 81/03/31 81/03/31
                                             8   .902500   .252735   .502728   1.76000   .410000 80/11/21 81/03/31
                                    K        2   1.00000   .000000   .000000   1.00000   1.00000 81/02/13 81/02/13
00665 PHOS-TOT              MG/L P  TOT     10   .922000   .198262   .445266   1.76000   .410000 80/11/21 81/03/31
00900 TOT HARD   CACO3      MG/L    J        9   1.50133   .440334   .663577   2.20000   .480000 80/11/21 81/03/31
00940 CHLORIDE   TOTAL      MG/L             1   129.000                       129.000   129.000 81/03/17 81/03/17
01045   IRON     FE,TOT     UG/L             1   2.20000                       2.20000   2.20000 81/03/17 81/03/17
01051 LEAD       PB,TOT     UG/L             9   22644.4  .261E+09   16181.3   54000.0   7900.00 81/01/06 81/03/31
01092 ZINC       ZN,TOT     UG/L             9   167.333   10595.3   102.933   350.000   21.0000 81/01/06 81/03/31
39730  2,4-D    WHL SMPL    UG/L             9   313.889   25056.8   158.293   654.000   150.000 81/01/06 81/03/31
39740 2,4,5-T   WHL SMPL    UG/L    K        1   .100000                       .100000   .100000 81/01/06 81/01/06
39760  SILVEX   WHL SMPL    UG/L    K        1   .040000                       .040000   .040000 81/01/06 81/01/06
                                    K        1   .040000                       .040000   .040000 81/01/06 81/01/06
```

No Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                        208LCOG-0031     WQ0031       S-Q-NBMAR2
                                                        44 03 52.0 122 59 01.0  2
                                                        MARCOLA RD DITCH ABOVE BMP NEAR 28TH STREET
                                                        41039 OREGON                LANE
/CANAL/TYPA/AMBNT/RUNOFF                                PACIFIC NORTHWEST           130900
                                                        WILLAMETTE RIVER
INDEX 1310001  001140  01790  0110    0020              10EPACOP  810228
MILES 0101.50 0182.30 004.40 000.40 000.55               0000  CLASS 00 CSN-RSP 0582221-0042708
PARAMETER                                  RMK  NUMBER    MEAN   VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
00008    LAB      IDENT.     NUMBER                  4 .000000   .000000  .000000   .000000   .000000 81/03/17 81/03/31
00010  WATER       TEMP       CENT                   3 9.33333   5.33350  2.30944   12.0000   8.00000 80/11/21 81/01/21
00095 CNDUCTVY    AT 25C    MICROMHO                11 154.455   4864.88  69.7487   308.000   68.0000 80/11/21 81/03/31
00335    COD     LOWLEVEL     MG/L                   9 578.889    115709  340.160   1180.00   241.000 80/11/21 81/03/31
00400    PH                    SU                    9 6.68888   .008636  .092933   6.80000   6.60000 81/01/06 81/03/31
00410  T ALK      CACO3       MG/L                   1 101.000                      101.000   101.000 81/03/17 81/03/17
00500 RESIDUE     TOTAL       MG/L                  10 959.700    389966  624.472   2274.00   366.000 80/11/21 81/03/31
00545 RESIDUE   SETTLBLE      ML/L                   4 .750000   .763334  .873690   2.00000   .100000 80/11/21 81/01/21
                                            J        1 .010000                      .010000   .010000 81/03/17 81/03/17
                                            K        3 .026667   .000133  .011547   .040000   .020000 81/03/31 81/03/31
                                            TOT      8 .386250   .478427  .691684   2.00000   .010000 80/11/21 81/03/31
00556 OIL-GRSE   FREON-GR     MG/L                  12 39.0250   2063.50  45.4256   158.000   3.30000 80/11/21 81/03/31
00615  NO2-N      TOTAL       MG/L                   1 .010000                      .010000   .010000 81/03/31 81/03/31
                                            J        1 .010000                      .010000   .010000 81/03/31 81/03/31
                                            TOT      2 .010000-.145E-10  .000000   .010000   .010000 81/03/31 81/03/31
00630 NO2&NO3    N-TOTAL      MG/L                   8 .952500   .380707  .617015   2.13000   .370000 80/11/21 81/03/31
                                            K        2 1.00000   .000000  .000000   1.00000   1.00000 81/02/13 81/02/13
                                            TOT     10 .962000   .296507  .544524   2.13000   .370000 80/11/21 81/03/31
00665 PHOS-TOT                MG/L P                 9 1.31667   .373799  .611391   2.10000   .450000 80/11/21 81/03/31
00900 TOT HARD    CACO3       MG/L                   1 119.000                      119.000   119.000 81/03/17 81/03/17
00940 CHLORIDE    TOTAL       MG/L                   1 4.50000                      4.50000   4.50000 81/03/17 81/03/17
01034 CHROMIUM   CR,TOT       UG/L          J        1 6.00000                      6.00000   6.00000 81/03/17 81/03/17
01042 COPPER     CU,TOT       UG/L                   1 60.0000                      60.0000   60.0000 81/03/17 81/03/17
01045   IRON     FE,TOT       UG/L                  10 19060.0 .180E+09  13428.5   49400.0   8200.00 81/01/06 81/03/31
01051 LEAD       PB,TOT       UG/L                  10 120.000   3974.44  63.0432   200.000   31.0000 81/01/06 81/03/31
01092 ZINC       ZN,TOT       UG/L                  10 266.500   19606.7  140.024   580.000   140.000 81/01/06 81/03/31
31616 FEC COLI   MFM-FCBR    /100ML                  1 10.0000                      10.0000   10.0000 80/11/21 80/11/21
39730  2,4-D     WHL SMPL     UG/L          K        2 .100000-.372E-08  .000000   .100000   .100000 81/01/06 81/02/13
39740 2,4,5-T    WHL SMPL     UG/L          K        2 .040000 .116E-08  .000034   .040000   .040000 81/01/06 81/02/13
39760  SILVEX    WHL SMPL     UG/L          K        2 .040000 .116E-08  .000034   .040000   .040000 81/01/06 81/02/13
```

No Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                                   208LCOG-0033      WQ0033          S-O-NBMAR3
                                                                   44 03 52.0 122 59 01.0  2
                                                                   MARCOLA RD DITCH ABV 2ND OIL TRAP AT 29TH ST.
                                                                   41039 OREGON                    LANE
/CANAL/TYPA/AMBNT/RUNOFF                                           PACIFIC NORTHWEST               130900
                                                                   WILLAMETTE RIVER
INDEX 1310001  001140  01790  0110    0020                         10EPACOP  810228
MILES 0101.50 0182.30 004.40 000.40 000.55                          0000  CLASS 00 CSN-RSP 0582223-0042710
PARAMETER
00008   LAB      IDENT.     NUMBER      RMK   NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM   MINIMUM  BEG DATE END DATE
00095 CHDUCTVY   AT 25C    MICROMHO                1  .000000
00335   COD     LOWLEVEL     MG/L                  3  29.6667  21.3343  4.61891  .000000   .000000 81/03/31 81/03/31
00400   PH                    SU                   2  706.500   104425  323.148  35.0000   27.0000 81/01/27 81/03/31
00500 RESIDUE    TOTAL       MG/L                  3  6.53333  .143425  .378715  935.000   478.000 81/01/27 81/03/31
00545 RESIDUE   SETTLBLE     ML/L                  2  1134.00  46208.0  214.960  6.80000   6.10000 81/01/27 81/03/31
00556 OIL-GRSE  FREON-GR     MG/L                  1  .200000                    1286.00   982.000 81/01/27 81/03/31
00615  NO2-N     TOTAL       MG/L        K         3  25.6667  296.334  17.2144  .200000   .200000 81/03/31 81/03/31
00630 NO2&NO3   N-TOTAL      MG/L                  1  .010000                    45.0000   12.0000 81/01/27 81/03/31
                                                   1  1.15000                    .010000   .010000 81/03/31 81/03/31
                                         K         1  1.00000                    1.15000   1.15000 81/03/31 81/03/31
00665 PHOS-TOT                           TOT       2  1.07500                    1.00000   1.00000 81/02/13 81/02/13
01045   IRON                MG/L P                 2  1.64000  .011250  .106064  1.15000   1.00000 81/02/13 81/03/31
01051 LEAD       FE,TOT      UG/L                  3  15100.0  .003200  .056565  1.68000   1.60000 81/02/13 81/03/31
01092 ZINC       PB,TOT      UG/L                  3  370.000  3129984  1769.18  17000.0   13500.0 81/01/27 81/03/31
                 ZN,TOT      UG/L                  3  250.333  7900.00  88.8819  440.000   270.000 81/01/27 81/03/31
                                                            870.375  29.5021  280.000   221.000 81/01/27 81/03/31
```

No Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                         208LCOG-0027    WQ0027          S-Q-58        FLOW0027
                                                         44 03 43.0 122 59 43.0  2
                                                         S BRANCH Q ST CHANNEL AT SHOPPING CENTER
                                                         41039 OREGON                LANE
/CANAL/TYPA/AMBNT/RUNOFF                                 PACIFIC NORTHWEST           130900
                                                         WILLAMETTE RIVER
INDEX 1310001  001140  01790                             10EPACOP  800531
MILES 0101.50 0182.30 004.70                              0000  CLASS 00 CSN-RSP 0551494-0042703
PARAMETER
00008   LAB      IDENT.    NUMBER    RMK  NUMBER   MEAN    VARIANCE STAN DEV  MAXIMUM   MINIMUM BEG DATE END DATE
00010   WATER    TEMP      CENT             15   .000000   .000000  .000000   .000000   .000000 76/04/20 81/01/06
00061   STREAM   FLOW,     INST-CFS         13   16.0769   18.4520  4.29558   23.0000   9.00000 76/04/20 81/01/06
                                             7   5.54286   29.2262  5.40612   16.0000   1.10000 79/12/10 80/11/21
                                      J      9   5.38889   85.7986  9.26276   30.0000   1.00000 76/04/20 81/01/06
00076    TURB    TRBIDMTR  HACH FTU   TOT   16   5.45625   57.4559  7.57997   30.0000   1.00000 76/04/20 81/01/06
00095 CNDUCTVY   AT 25C    MICROMHO         14   61.4428   7021.97  83.7972   300.000   2.10000 79/10/30 81/01/06
00300    DO                MG/L             16   196.625   6316.91  79.4790   308.000   78.0000 76/04/20 81/01/06
00315    BOD     7 DAY     MG/L              9   8.49777   3.07657  1.75401   10.5000   5.30000 80/01/14 81/01/06
00324    BOD     20 DAY    MG/L              4   6.14500   8.72414  2.95366   10.0800   3.30000 76/04/20 80/03/10
                                             4   27.9500   375.283  19.3722   57.0000   17.8000 80/05/09 81/01/06
                                      L      3   22.1667   170.044  13.0401   36.0000   10.1000 80/05/06 80/10/08
00335    COD                          TOT    7   25.4714   253.879  15.9336   57.0000   10.1000 80/05/06 81/01/06
00400    PH      LOWLEVEL  MG/L             15   54.7399   1964.04  44.3175   170.000   10.9000 76/04/20 81/01/06
00410  T ALK               SU               16   7.33750   .118473  .344199   8.00000   6.70000 76/04/20 81/01/06
                 CACO3
00500 RESIDUE    TOTAL     MG/L             14   82.1428   1574.70  39.6824   138.000   27.5000 79/10/30 81/01/06
00530 RESIDUF    TOT NFLT  MG/L             15   242.533   14470.1  120.292   590.000   118.000 76/04/20 81/01/06
00545 RESIDUE    SETTLBLE  ML/L             11   68.3636   11320.3  106.397   330.000   3.00000 76/04/20 80/11/21
                                             4   .717500   .282558  .531562   1.30000   .120000 80/01/14 80/11/21
                                      K      4   .032500   .002025  .045000   .100000   .010000 79/12/10 81/01/06
00556 OIL-GRSE   FREON-GR  MG/L       TOT    8   .375000   .256028  .505992   1.30000   .010000 79/12/10 81/01/06
                                             2   2.30000   .080005  .282851   2.50000   2.10000 80/11/21 80/11/21
                                      K      2   1.00000   .000000  .000000   1.00000   1.00000 80/03/10 80/05/09
00610 NH3+NH4-   N TOTAL   MG/L       TOT    4   1.65000   .590001  .768115   2.50000   1.00000 80/03/10 80/11/21
                                            13   1.00923   .774506  .880060   3.00000   .200000 79/10/30 81/01/06
                                      J      1   5.00000                      5.00000   5.00000 80/10/08 80/10/08
00615  NO2-N     TOTAL     MG/L       TOT   14   1.29428   1.85252  1.36107   5.00000   .200000 79/10/30 81/01/06
                                             7   .294285   .102662  .320409   1.00000   .090000 80/03/10 81/01/06
                                      K      2   .100000-.372E-08   .000000   .100000   .100000 79/12/10 80/01/14
00625 TOT KJEL   N         MG/L       TOT    9   .251111   .084336  .290407   1.00000   .090000 79/12/10 81/01/06
                                             2   .944999   1.46205  1.20915   1.80000   .090000 80/03/10 80/10/08
                                      K      2   .010000-.145E-10   .000000   .010000   .010000 80/11/21 81/01/06
00630 NO2&NO3    N-TOTAL   MG/L       TOT    4   .477499   .778757  .882472   1.80000   .010000 80/03/10 81/01/06
00665 PHOS-TOT             MG/L P           13   .775384   .211827  .460247   1.70000   .250000 77/01/11 81/01/06
00680 T ORG C    C         MG/L             14   .392285   .052958  .230127   .990000   .153000 76/04/20 81/01/06
00900 TOT HARD   CACO3     MG/L              5   32.7600   679.027  26.0581   77.0000   8.20000 80/03/10 81/01/06
00940 CHLORIDE   TOTAL     MG/L             13   70.1999   923.597  30.3907   110.000   29.8000 79/10/30 81/01/06
00945 SULFATE    SO4-TOT   MG/L             13   4.44230   3.21161  1.79210   6.90000   1.70000 76/04/20 81/01/06
                                             4   3.60000   3.20666  1.79071   5.50000   1.20000 79/10/30 80/07/08
                                      K      1   10.0000                      10.0000   10.0000 80/01/14 80/01/14
00956  SILICA    TOTAL     MG/L       TOT    5   4.88000   10.5970  3.25531   10.0000   1.20000 79/10/30 80/07/08
                                             1   18.0000                      18.0000   18.0000 77/01/11 77/01/11
```

No Duplicates

218

53

```
STORET RETRIEVAL DATE 82/01/18 - INVENT - VERSION OF SEP. 1981
                                                   208LCOG-0027     WQ0027          5-0-SB        FLOW0027
                                                   44 03 43.0 122 59 43.0  2
                                                   S BRANCH Q ST CHANNEL AT SHOPPING CENTER
                                                   41039 OREGON                 LANE
   /CANAL/TYPA/AMBNT/RUNOFF                        PACIFIC NORTHWEST            130900
                                                   WILLAMETTE RIVER
   INDEX 1310001  001140  01790                    10EPACOP  800531
   MILES 0101.50 0182.30 004.70                     0000  CLASS 00 CBN-RSP 0551494-0042703
   PARAMETER
                                          RMK   NUMBER     MEAN  VARIANCE STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
   01002 ARSENIC    AS,TOT       UG/L     J          3  5.33333  2.33334  1.52753  7.00000   4.00000  80/11/21 80/11/21
   01034 CHROMIUM   CR,TOT       UG/L                4  8.00000  7.33333  2.70801  10.0000   4.00000  80/01/14 80/11/21
                                          J          9  1.33333  3.50000  1.87083  5.00000   .000000  79/10/30 81/01/06
                                          TOT       13  3.38461  14.4231  3.79777  10.0000   .000000  79/10/30 81/01/06
   01042 COPPER     CU,TOT       UG/L                7  27.7571  800.713  28.2969  78.0000   2.00000  80/01/14 81/01/06
                                          J          6  3.83333  8.96668  2.99444  9.00000   2.00000  79/10/30 80/07/08
                                          TOT       13  16.7154  558.187  23.6260  78.0000   2.00000  79/10/30 81/01/06
   01045   IRON     FE,TOT       UG/L               13  3528.46 .131E+08  3631.31  11400.0   240.000  79/10/30 81/01/06
   01051 LEAD       PB,TOT       UG/L               11  52.6545  4539.07  67.3726  197.000   2.00000  79/10/30 81/01/06
                                          J          2  4.00000  2.00000  1.41421  5.00000   3.00000  80/03/10 80/05/06
                                          TOT       13  45.1692  4116.57  64.1605  197.000   2.00000  79/10/30 81/01/06
   01067  NICKEL    NI,TOTAL     UG/L     K          9  100.000  .000000  .000000  100.000   100.000  79/10/30 80/10/08
   01092 ZINC       ZN,TOT       UG/L                7  75.0000  3192.33  56.5007  165.000   10.0000  79/10/30 81/01/06
                                          J          6  18.5000  133.900  11.5715  30.0000   1.00000  79/12/10 80/07/08
                                          TOT       13  48.9231  2511.41  50.1140  165.000   1.00000  79/10/30 81/01/06
   31616 FEC COLI   MFM-FCBR    /100ML              11  1386.82  3419030  1849.06  5800.00   20.0000  76/04/20 80/11/21
   39390 ENDRIN               TOT UG/L    K          1  .100000                     .100000   .100000  80/11/21 80/11/21
   39400 TOXAPHEN              TOTUG/L    K          1  5.00000                     5.00000   5.00000  80/11/21 80/11/21
   39480 MTHXYCLR   WHL SMPL     UG/L     K          1  .200000                     .200000   .200000  80/11/21 80/11/21
   39530 MALATHN    WHL SMPL     UG/L     K          1  10.0000                     10.0000   10.0000  80/11/21 80/11/21
   39570 DIAZINON   WHL SMPL     UG/L     K          1  2.00000                     2.00000   2.00000  80/11/21 80/11/21
   39782 LINDANE    WHL SMPL     UG/L     K          1  .050000                     .050000   .050000  80/11/21 80/11/21
   71900 MERCURY    HG,TOTAL     UG/L     K          6  .500000  .000000  .000000  .500000   .500000  79/10/30 80/11/21
```

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                          208LCOG-0028     WQ0028        S-CC-72TH     FLOW0028
                                                          44 03 07.0 122 53 45.0  2
                                                          72ND STREET CHANNEL AT THURSTON ROAD
                                                          41039 OREGON                  LANE
/CANAL/TYPA/AMBNT/RUNOFF                                  PACIFIC NORTHWEST             130900
                                                          WILLAMETTE RIVER
INDEX 1310001   001140   01730   0126    0100    0100     10EPACOP  800531
MILES 0101.50 0171.80 016.60 001.80 001.50 000.05          0000  CLASS 00 CSN-RSP 0551495-0042705
PARAMETER
                                        RMK  NUMBER     MEAN   VARIANCE  STAN DEV   MAXIMUM   MINIMUM  BEG DATE END DATE
00008   LAB      IDENT.     NUMBER             6    .000000   .000000   .000000   .000000   .000000  79/12/10 81/01/06
00010  WATER      TEMP       CENT              6    11.0000   13.3000   3.64692   18.0000   8.50000  79/12/10 81/01/06
00061  STREAM     FLOW,     INST-CFS           2    6.50000   72.0000   8.48528   12.5000   .500000  80/03/10 81/01/06
                                         J     4    8.27500   210.369   14.5041   30.0000   .100000  79/12/10 80/07/08
                                        TOT    6    7.68333   141.462   11.8938   30.0000   .100000  79/12/10 81/01/06
00076   TURB    TRBIDMTR    HACH FTU           6    26.9667   406.967   20.1734   67.0000   9.80000  79/12/10 81/01/06
00095 CNDUCTVY   AT 25C     MICROMHO           6    58.0000   136.000   11.6619   75.0000   42.0000  79/12/10 81/01/06
00300    DO                   MG/L             5    10.6200   1.17706   1.08493   12.1000   9.10000  80/01/14 81/01/06
00315    BOD      7 DAY       MG/L             2    2.46000   .007204   .084877   2.52000   2.40000  80/01/14 80/03/10
00324    BOD     20 DAY       MG/L             3    3.50000   .190010   .435901   4.00000   3.20000  80/05/06 81/01/06
00335    COD    LOWLEVEL      MG/L             6    9.34999   34.0470   5.83498   20.8000   4.20000  79/12/10 81/01/06
00400    PH                    SU              6    6.91666   .101709   .318918   7.30000   6.40000  79/12/10 81/01/06
00410  T ALK      CACO3       MG/L             6    21.7333   31.4989   5.61239   30.9000   13.8000  79/12/10 81/01/06
00500 RESIDUE     TOTAL       MG/L             6    100.667   3471.87   58.9226   220.000   67.0000  79/12/10 81/01/06
00530 RESIDUE    TOT NFLT     MG/L             6    22.6166   2062.55   45.4153   115.300   2.40000  79/12/10 81/01/06
00545 RESIDUE    SETTLBLE     ML/L             1    .010000                       .010000   .010000  80/03/10 80/03/10
                                         J     1    .010000                       .010000   .010000  80/01/14 80/01/14
                                         K     2    .055000   .004050   .063640   .100000   .010000  79/12/10 81/01/06
                                        TOT    4    .032500   .002025   .045000   .100000   .010000  79/12/10 81/01/06
00556 OIL-GRSE   FREON-GR     MG/L             1    37.0000                       37.0000   37.0000  80/03/10 80/03/10
00610 NH3+NH4-   N TOTAL      MG/L       K     6    .100000-.223E-08  .000000   .100000   .100000  79/12/10 81/01/06
00615  NO2-N      TOTAL       MG/L             1    .020000                       .020000   .020000  81/01/06 81/01/06
                                         K     5    .100000-.279E-08  .000000   .100000   .100000  79/12/10 80/07/08
                                        TOT    6    .086667   .001067   .032660   .100000   .020000  79/12/10 81/01/06
00625 TOT KJEL      N         MG/L             1    .100000                       .100000   .100000  80/03/10 80/03/10
                                         K     1    .010000                       .010000   .010000  81/01/06 81/01/06
                                        TOT    2    .055000   .004050   .063640   .100000   .010000  80/03/10 81/01/06
00630 NO2&NO3    N-TOTAL      MG/L             4    .185000   .000900   .030000   .200000   .140000  79/12/10 81/01/06
                                         K     2    .100000-.372E-08  .000000   .100000   .100000  80/03/10 80/05/06
                                        TOT    6    .156667   .002467   .049666   .200000   .100000  79/12/10 81/01/06
00665 PHOS-TOT               MG/L P            6    .105000   .005634   .075063   .237000   .052000  79/12/10 81/01/06
00680 T ORG C       C         MG/L             2    5.95000   .604996   .777815   6.50000   5.40000  80/03/10 81/01/06
00900 TOT HARD    CACO3       MG/L             5    20.2600   4.07361   2.01832   22.5000   17.3000  79/12/10 81/01/06
00940 CHLORIDE    TOTAL       MG/L             6    1.98333   .256668   .506624   2.75000   1.40000  79/12/10 81/01/06
00945 SULFATE    SO4-TOT      MG/L             2    1.15000   .045000   .212132   1.30000   1.00000  79/12/10 80/03/10
                                         K     1    1.00000                       1.00000   1.00000  80/07/08 80/07/08
                                        TOT    3    1.10000   .030001   .173208   1.30000   1.00000  79/12/10 80/07/08
01034 CHROMIUM   CR,TOT       UG/L       J     6    .666667   1.46667   1.21106   3.00000   .000000  79/12/10 81/01/06
01042 COPPER     CU,TOT       UG/L             1    2.00000                       2.00000   2.00000  81/01/06 81/01/06
                                         J     5    3.20000   5.20000   2.28035   6.00000   1.00000  79/12/10 80/07/08
                                        TOT    6    3.00000   4.40000   2.09762   6.00000   1.00000  79/12/10 81/01/06
```

No Duplicates

```
STORET RETRIEVAL DATE 82/01/18  -  INVENT - VERSION OF SEP. 1981
                                                           208LCOG-0028    W00028        S-CC-72TH    FLOW0028
                                                           44 03 07.0 122 53 45.0  2
                                                           72ND STREET CHANNEL AT THURSTON ROAD
                                                           41039 OREGON                 LANE
                                                           PACIFIC NORTHWEST            130900
 /CANAL/TYPA/AMBNT/RUNOFF                                  WILLAMETTE RIVER
                                                           10EPACOP  800531
 INDEX 1310001  001140  01730  0126   0100   0100          0000  CLASS 00 CSN-RSP 0551495-0042705
 MILES 0101.50 0171.80 016.60 001.80 001.50 000.05
 PARAMETER                                  RMK   NUMBER    MEAN    VARIANCE  STAN DEV  MAXIMUM   MINIMUM  BEG DATE END DATE
 01045  IRON       FE,TOT       UG/L                  6   2920.00  .133E+08  3656.23   10200.0   390.000  79/12/10 81/01/06
 01051 LEAD        PB,TOT       UG/L                  1   1.00000                      1.00000   1.00000  81/01/06 81/01/06
                                            J         5   1.60000  1.30000   1.14018   3.00000   .000000  79/12/10 80/07/08
                                            TOT       6   1.50000  1.10000   1.04881   3.00000   .000000  79/12/10 81/01/06
 01067  NICKEL     NI,TOTAL     UG/L        K         5   100.000  .000000   .000000   100.000   100.000  79/12/10 80/07/08
 01092 ZINC        ZN,TOT       UG/L                  1   .000000                      .000000   .000000  81/01/06 81/01/06
                                            J         5   10.2000  45.7001   6.76018   22.0000   5.00000  79/12/10 80/07/08
                                            TOT       6   8.50000  53.9000   7.34166   22.0000   .000000  79/12/10 81/01/06
 31616 FEC COLI    MFM-FCBR     /100ML                5   741.000  1669830   1292.22   3040.00   10.0000  79/12/10 81/01/06
                                            K         1   10.0000                      10.0000   10.0000  80/05/06 80/05/06
                                            TOT       6   619.166  1424924   1193.70   3040.00   10.0000  79/12/10 81/01/06
 71900 MERCURY     HG,TOTAL     UG/L        K         1   .500000                      .500000   .500000  79/12/10 79/12/10
```

STORM DATA CATALOG
EUGENE

Dates	Time Period (Hours)	No. of Samples	Flow Measurement	Rainfall Record-Distance from Site	Notes
1. AMAZON CREEK at Veg. Site #1 Near Danebo Drive					
05/09/80	10:00-12:00 (2)	2	USGS-continuous	Airport - 5-1/4 mi. Roosevelt - 3 mi.	1,4,5
06/24/80	08:00-15:00 (7)	4	"	"	
09/02/80	10:10-13:25 (3-1/4)	2	"	"	
12/02/80	09:10-17:40 (8-1/2)	4	"	"	
03/31/81	14:20-19:52 (5-1/2)	3	"	"	
2. AMAZON CREEK @ Veg. Site #2 Near Danebo Drive					
05/09/80	09:45-12:25 (2-3/4)	2	USGS-continuous	Airport - 5-1/4 mi. Roosevelt - 3 mi.	1,4,5
06/24/80	07:40-14:50 (7-1/4)	4	"	"	
09/02/80	09:55-13:10 (3-1/4)	2	"	"	
3. AMAZON CREEK at Veg. Site #3 Near Danebo Drive					
05/09/80	09:45-12:25 (2-3/4)	2	USGS-continuous	Airport - 5-1/4 mi. Roosevelt - 3 mi.	1,4,5
06/24/80	07:40-14:50 (7-1/4)	4	"	"	
09/02/80	09:55-13:10 (3-1/4)	2	"	"	
03/31/81	14:00-19:35 (5-1/2)	2	"	"	
4. AMAZON CREEK at Oak Patch Road					
01/07-08/76	10:08-08:14 (22)	10	Staff - 10	Airport - 6-1/2 mi.	2,4
02/14/76	18:10-20:10 (2)	2	Staff - 2	"	
08/13-14/76	19:14-13:50 (18-1/4)	18	Staff - 18	"	
10/10/76	11:05-12:45 (2-1/2)	2	Staff - 2	"	
10/24/76	11:00-18:20 (8-1/4)	11	Staff - 11	"	
11/17/76	15:30-23:50 (8)	4	Staff - 4	"	
06/24/80	07:03-15:30 (7-1/2)	5	Staff - 5	Airport - 6-1/2 mi. Roosevelt - 1-1/4 mi. 32nd Street - 3 mi.	5,6
09/02/80	09:20-14:00 (4-1/2)	3	Staff - 3	"	
12/02/80	08:30-17:25 (9)	4	Staff - 3	"	
5. AMAZON CREEK at Washington Street					
no storm data					

6. AMAZON CREEK at 29th Street

03/15/81	07:10-12:55 (5-1/2)	3	Staff - 3	32nd Street - 1/2 mi.	2,6
03/31/81	13:15-19:10 (6)	5	Staff - 5	"	

7. AMAZON CREEK above 29th Street

03/15/81	06:55-12:45 (6)	3	Staff - 3	32nd Street - 1/2 mi.	2,6
03/31/81	13:05-18:45 (5-1/2)	3	Staff - 3	"	

8. A-2 CHANNEL at Golden Gardens

no storm data

9. A-3 CHANNEL at Bertelsen Road

09/14/76	04:20-10:10 (6)	5	Staff - 5	Airport - 5 mi.	2,4,5
10/24/76	11:00-14:00 (3)	4	Staff - 4	Roosevelt - 2-1/2 mi.	
06/24/80	08:20-15:15 (7)	6	Staff - 5	"	
12/02/80	09:35-18:35 (9)	4	Staff - 4	"	
03/31/81	14:45-17:20 (2-1/2)	3	Staff - 3	"	
05/05/81	09:35-20:45 (11)	10	Staff - 55	"	
10/27-28/81	10:50-04:00 (5)	10	Staff - 11	"	

10. A-3 CHANNEL at Wallis Street

06/24/80	06:35-14:08 (7-1/2)	5	Staff - 5	Airport - 5-1/4 mi.	2,4,5
12/02/80	09:25-18:10 (8-1/2)	4	Staff - 4	Roosevelt - 2-1/2 mi.	
03/31/81	12:30-18:22 (6)	3	Staff - 3	"	

11. POLK STREET STORM SEWER at Discharge

09/14/76	03:45-09:50 (6)	8	Staff - 8	Airport - 6-1/2 mi.	3,4
10/24/76	10:25-17:15 (7)	7	Staff - 7	"	
02/02/80	10:00-18:55 (9)	6	Staff - 6	Roosevelt - 1/2 mi.	3,5
05/05/81	09:20-16:15 (7)	9	Staff - 48	"	
06/06/81	08:15-10:55 (2-1/2)	2	Staff - 10	"	
10/27-28/81	20:10-02:30 (6-1/2)	5	Staff - 39	"	

12. EUGENE MILLRACE at Mill Street

no storm data

NOTES:

1. The USGS Gage is approximately 1-1/4 miles downstream from Danebo Drive -- it is a continuous recorder with hourly printout.

2. Staff gages at Oak Patch, 29th and A-3 are enamel gages with flow values derived from measured flow rating curves.

3. The staff gage at Polk Street prior to 1980 was a float recorder and rating curve -- for 1980-81 the staff consists of painted marks in the outfall pipe and flows are derived from the Manning formula.

4. Rainfall data at the Airport is operated by the U.S. Weather Service with hourly rainfall records.

5. Rainfall at Roosevelt Boulevard is operated by Eugene and is a tipping bucket with hourly values -- established in November 1979.

6. Rainfall at 32nd Street is operated by Eugene and is a tipping bucket with hourly values -- it began operation on January 16, 1980.

STORM DATA CATALOG
SPRINGFIELD

Dates	Time Period (Hours)	No. of Samples	Flow Measurement	Rainfall Record- Distance from Site	Notes
1. SPRINGFIELD MILLRACE Near Mouth					
05/09/80	10:15-14:50 (3-1/2)	3	Staff Gage - 3	Airport - 10-1/2 mi. Spfld STP - 3/4 mi.	1
09/02/80	08:15-11:20 (3)	3	Staff Gage - 3	"	
11/21/80	13:22-23:15 (8)	4	Staff Gage - 4	"	
03/31/81	12:45-17:40 (5)	3	Staff Gage - 3	"	
2. STORM DRAINS to Spfld Millrace - 2 Drains					
09/14/76	04:20-09:14 (5)	6	Weir & Level Recorder (PMX) (Semi-Continuous)	Airport - 10-1/2 mi.	2
10/24/76	11:45-16:15 (4-1/2)	6	"	"	
11/17/76	14:30-? (7?)	7	"	"	
12/08/76	12:53-16:15 (3-1/2)	5	"	"	
3. STORM DRAIN to Island Park					
09/14/76	04:20- 09:14 (5)	6	Weir & Level Recorder (PMX) (Semi-Continuous)	Airport - 10-1/2 mi.	2
10/24/76	12:25-16:05 (3-1/2)	5	"	"	
12/08/76	14:15-16:00 (1-1/2)	2	"	"	
4. Q CHANNEL Near Skipworth Home - Centennial Boulevard					
01/05/76	15:45	1	Estimate	Airport - 8 mi. Spfld STP- 1-3/4 mi.	3
01/11/77	10:45-16:00 (4-1/2)	2	Estimates	"	
01/14/80	13:15	1	Estimate	"	
5. Q CHANNEL at Garden Way					
01/14/80	13:40	1	USGS Staff & Weir-1	Airport - 8-3/4 mi. Spfld STP - 3/4 mi.	4
05/09/80	09:56-14:30 (4-1/2)	2	"	"	
09/02/80	08:50-12:00 (3)	3	"	"	
11/21/80	11:40-23:30 (12)	4	"	"	
03/31/81	13:15-18:00 (4-3/4)	4	"	"	

6. Q CHANNEL at Quinalt (Drop Structure)

10/24/76	10:38-19:10 (8-1/2)	7	Staff Gauge & Square Weir (PMX)-7	Airport - 9 mi.	5
11/17/76	14:45-23:50 (9)	5	Staff Gauge & Square Weir (PMX)-5	"	
12/08/76	13:05-20:00 (7)	6	Staff Gauge & Square Weir (PMX)-6	"	
01/11/77	10:30-15:50 (2)	2	Staff Gauge & Square Weir (PMX)-2	"	
02/20-21/77	14:00-12:00 (22)	2	"	"	

7. Q CHANNEL at 2nd Street

01/11/77	10:00-15:35 (5-1/2)	2	Staff Gauge-Flow Rated (L-COG)-2	Airport - 9-3/4 mi. Spfld STP - 1 mi.	6
01/14/80	13:10	1	Staff Gauge-Flow Rated (L-COG)-1	"	
05/09/80	09:42-14:15 (4-1/2)	2	Staff Gauge-Flow Rated (L-COG)-2	"	
09/02/80	08:30-11:45 (3+)	4	Staff Gauge-Flow Rated (L-COG)-4	"	
11/21/80	12:14-23:03 (11)	4	"	"	
03/31/81	12:30-17:30 (5)	4	"	"	

8. NORTH BRANCH Q CHANNEL at Mohawk Boulevard

01/14/80	11:30	1	Staff Gauge-Flow Rated (L-COG)-1	Airport - 11-3/4 mi. Spfld STP- 2-1/4 mi. Spfld Shop-1-1/4 mi.	7,8
05/09/80	09:21-14:00 (4-1/2)	2	Staff Gauge-Flow Rated (L-COG)-2	"	

9. MARCOLA ROAD INDUSTRIAL DITCH - 3 Sites

11/21/80	14:30-18:15 (3-1/2)	2-3	Culvert Flow Estimates - 2	Airport - 11-3/4 mi. Spfld STP- 2-1/4 mi. Spfld Shop-1-1/4 mi.	7,8
01/27/81	10:02-16:15 (6)	2	"	"	
02/13/81	09:10-11:00 (2)	2	"	"	
03/31/81	12:20-17:10 (3)	3	Culvert Flow Estimates - 3	"	

10. SOUTH BRANCH Q CHANNEL at Marcola Center

01/14/80	11:40	1	Concrete Weir & Staff Gauge-1	Airport - 11-3/4 mi. Spfld STP- 2-1/4 mi. Spfld Shop-1-1/4 mi.	6,8
05/09/80	09:10-13:45 (4-1/2)	2	Concrete Weir & Staff Gauge-2	"	
11/21/80	13:00-22:50 (9)	4	"	"	

11. 72ND STREET CHANNEL

01/14/80	11:00	1	Concrete Weir & Staff Gauge-1	Airport - 17-1/4 mi. Spfld STP- 7-1/2 mi. Spfld Shop - 5 mi.	6,8

NOTES:

1. Records at Springfield Sewage Treatment Plant (STP) are not continuous but are read only three times per day from a glass accumulation gage.
2. Weir established in circular pipe and rating curve established using a continuous recording float device - gaging done by Parametrix, Inc. (PMX).
3. Flows are similar to "Q" at Garden Way due to restricted input between stations.
4. Rated flow curve established USGS using enamel steel gage and velocity meters.
5. Rated flow curve established by Parametrix, Inc. (PMX), using continuous recording float gage.
6. Staff gage (enamel steel) and rated natural channel by L-COG staff from 1980.
7. Flow measurements made using culvert velocity readings and standard curves.
8. Rain gage at Springfield Shops (So. 18th in Springfield) read irregularly and only twice daily using cumulative glass gage.

APPENDIX D

MODELING

CONTENTS

SAM Model Printouts on Roosevelt Basin - September 30, 1981

SAM Updated Model Printouts on Roosevelt Basin - October 22, 1981

Digitized Drainage Basins

#1

SAM Model Printouts
City of Eugene

For Bimodal (BM) Storm on Roosevelt Basin
Kinematic Wave Routing

NOTE: Storm chosen to include but not exceed:

12-hour 10-year intensity
6-hour 10-year intensity
1-hour 10-year intensity

Date: September 30, 1981

Contact: Brian Shelton, Eugene Public Works

```
    1   //CE77CIK JOB   98770000,'KND  RJE'
        ***JOBPARM      T=01,L=020,D=000,Q=001                              E7701           JOB  272
    2   //JOBLIB DD DSN=USER.LINKLIB,DISP=SHR                                               JOB  272
        ***OUTPUT          HOLD
        ***ROUTE PRINT CE01
        ****************************************************************************       JOB  272
        ***                                                                                 JOB  272
        ***                              S A M   J C L
        ***                                                                         *
        ***    PARM='SWITCH=1'       FOR DEBUGGING ---                              *
        ***                                   PRINTS INTERNAL NODE AND LINE #S      *
        ***    PARM='SWITCH=2'       FOR NORMAL RUNS                                *
        ****************************************************************************
    3   //SAM  EXEC  PGM=CESAM00,PARM='SWITCH=2'
    4   //STEPLIB    DD  DSN=TEST.LINKLIB,DISP=SHR
    5   //FT01F001   DD  DSN=CE.SOURCE(E8BLSSAM),DISP=SHR,      <-----<<< DATA
        //    LABEL=(,,,IN)
    6   //FT02F001   DD  DUMMY
    7   //FT03F001   DD  SYSOUT=A,                              <-----<<< PLOT TAPE
        //    DCB=(RECFM=FA,BLKSIZE=133,LRECL=133)
    8   //FT04F001   DD  DSN=CE.SAM.BASIN,DISP=OLD
    9   //FT05F001   DD  DSN=CE.SAM.WORK,DISP=OLD
   10   //FT06F001   DD  DSN=CE.SAM.CONTROL,DISP=OLD
   11   //FT07F001   DD  DSN=CE.SAM.NODE,DISP=OLD
   12   //FT08F001   DD  DSN=CE.SAM.LINE,DISP=OLD
   13   //FT09F001   DD  DSN=CE.SAM.OUT,DISP=OLD
   14   //SYSUDUMP   DD  SYSOUT=(V,,0171)
```

```
THE DEBUG SWITCH HAS BEEN SET AS: 2
*INITIALIZE
*SETUP ROOSEVELT



*CONTROL
*HYETOGRAPHS
*********
********     IS AN INVALID COMMAND - RECORD IGNORED

*SOILS
*SECTIONS
*NODES
*LINES
*STORM
*SANITARY CURVES
*ANALYZE  STORM  KINEMATIC WAVE
NO APPARENT FATAL ERRORS
BEGINNING OVERLAND FLOW ANALYSIS
    * RUNOFF SUMMARY *
      VOLUME OF RAINFALL                      10037392.00 CU FT   230.4268 AC FT
      VOLUME LOST TO INFILTRATION              1390018.00 CU FT    31.9104 AC FT
      VOLUME LOST TO I AND D STORAGE            665531.88 CU FT    15.2785 AC FT
      VOLUME REMAINING ON LAND SURFACE               0.0  CU FT     0.0    AC FT
      VOLUME REMAINING IN GUTTERS                    0.0  CU FT     0.0    AC FT
      VOLUME OF STORM RUNOFF                   7981722.00 CU FT   183.2351 AC FT
      VOLUME ENTERING CONVEYANCE SYSTEM        7981797.00 CU FT   183.2369 AC FT
BEGINNING INFILTRATION ANALYSIS

    TOTAL VOLUME OF PIPE INFILTRATION -     32691.84CU FT     0.7505 AC FT
BEGINNING KINEMATIC WAVE ANALYSIS
IHC208I IBCOM - PROGRAM INTERRUPT (P) -  UNDERFLOW   OLD PSW IS  078D000DA20B4BE6 . REGISTER CONTAINED    FFE4200000000000
TRACEBACK  ROUTINE  CALLED FROM ISN   REG. 14   REG. 15   REG.  0   REG.  1
```

```
CONTROL COMMAND DATA
TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- LIGHT STORM                                                          CESAM11-LTCNT




DEFAULT VALUES AND CODES FOR...

HYDROGRAPH TIME       PAN          MANNING'S N        CODE FOR        CODE FOR         CODE FOR         CODE FOR
   INCREMENT       EVAPORATION      CIRCULAR           STORM        STORM RUNOFF      POPULATION          PIPE
     (MIN)          (IN/DAY)         SECTION         REFERENCE       CONDITIONS         DENSITY       INFILTRATION
-----------------------------------------------------------------------------------------------------------------
     30.00             0.10            0.0130            BM              R1               A1               II


PIPE INFILTRATION CODES AND RATES IN GPD FOR 12 IN. CIRCULAR PIPE

CODE    INFIL          CODE   INFIL          CODE   INFIL          CODE   INFIL          CODE   INFIL

-----------------------------------------------------------------------------------------------------------
 II     600.0           ZZ     0.0                   0.0                   0.0                   0.0

HYETOGRAPHS FOR OVERLAND FLOW CALCULATIONS

   STORM              TIME                                                                                        CESAM11-LTHYE
IDENTIFICATION                         RAINFALL
                                       INTENSITY
                      (MIN)             (IN/HR)
------------------------------------------------
     BM                 0.0              0.000
                       30.0              0.050
                       60.0              0.050
                       90.0              0.200
                      120.0              0.350
                      150.0              0.600
                      180.0              0.500
                      210.0              0.300
                      240.0              0.150
                      270.0              0.100
                      300.0              0.000
                      330.0              0.150
                      360.0              0.350
                      390.0              0.650
                      420.0              0.850
                      450.0              0.720
                      480.0              0.520
                      510.0              0.250
                      540.0              0.150
                      570.0              0.100
                      600.0              0.050
                      630.0              0.000
                      660.0              0.050
                      690.0              0.050
                      720.0              0.050
```

232

Reproduced from
best available copy.

```
CODES AND TABLE VALUES FOR SOIL AND LAND SURFACE CONDITIONS                                                    CESAM12-LTSPL

CODE      FO          FC          K          FCI        ISD DEPTH    PERCENT    PERCENT
       (IN/HR)     (IN/HR)    (1/MIN)     (IN/HR)        (IN)         FULL     PERVIOUS
-----------------------------------------------------------------------------------------
 F1      0.50        0.10       0.069       0.21         0.15         25.0       60.0
 M1      0.50        0.10       0.069       0.21         0.15         25.0       20.0




*** DATA PERTAINING TO DRY WEATHER (SANITARY) FLOW ***

AVERAGE DOMESTIC FLOW PER CAPITA =  100.0                                                                      CESAM12-LTSNC

PEAKING FACTOR CURVE

   CLOCK     PEAKING
    TIME      FACTOR
  ------------------
      0      1.000
      6      1.000
     12      1.000
     18      1.000
     24      1.000

POPULATION CODES AND DENSITIES IN PERSONS PER ACRE

CODE   DENSITY       CODE   DENSITY       CODE   DENSITY       CODE   DENSITY       CODE   DENSITY

 AA      0.0
```

```
**** SECTION PROPERTIES ****

THE FOLLOWING COEFFICIENTS ARE OF THE FORM-
     Y=C1+C2(X)+C3(X**2)+C4(X**3)


SECTION CODE T1

       TOTAL AREA = F(DEFINING DIMENSION)
       ----------------------------------

          0.0       10.0000000 2.0000000 0.0

       WETTED PERIMETER FULL = F(DEFINING DIMENSION)
       ---------------------------------------------

          0.0       19.8036499-5.9979982 0.6663327

       C/CFULL = F(A/AFULL)
       --------------------

         -0.0147240 0.7060497 0.0        0.3093708

       A/AFULL = F(DEPTH/DEFINING DIMENSION)
       -------------------------------------

          0.0       0.4999897 0.5000008 0.0

       DEPTH/DEFINING DIMENSION = F(A/AFULL)
       -------------------------------------

          0.0183960 1.3031597 0.0       -0.3224227

       WETTED PERIMETER/WETTED PERIMETER FULL = F(DEPTH/DEFINING DIMENSION)
       --------------------------------------------------------------------

          0.3069999 0.6909997 0.0004000-0.0003000

       MANNING'S N = F(DEPTH/DEFINING DIMENSION)
       -----------------------------------------

          0.0330000 0.0       0.0       0.0


SECTION CODE T2

       TOTAL AREA = F(DEFINING DIMENSION)
       ----------------------------------

          0.0       10.0000000 2.0000000 0.0

       WETTED PERIMETER FULL = F(DEFINING DIMENSION)
       ---------------------------------------------

          0.0       12.9005594-1.9999962 0.1428568

       C/CFULL = F(A/AFULL)
       --------------------

          0.0       0.3430298 1.0655231-0.4085527
```

Reproduced from best available copy.

```
    A/AFULL = F(DEPTH/DEFINING DIMENSION)
    -------------------------------------

      0.0        0.4172097 0.5816478 0.0011430

    DEPTH/DEFINING DIMENSION = F(A/AFULL)
    -------------------------------------

      0.0        1.9976292-1.8432331 0.8456076

    WETTED PERIMETER/WETTED PERIMETER FULL = F(DEPTH/DEFINING DIMENSION)
    --------------------------------------------------------------------

      0.2429999 0.7579997-0.0267000 0.0279000

    MANNING'S N = F(DEPTH/DEFINING DIMENSION)
    -----------------------------------------

      0.0330000 0.0        0.0        0.0


SECTION CODE T3

    TOTAL AREA = F(DEFINING DIMENSION)
    ----------------------------------

      0.0        3.0000000 2.0000000 0.0

    WETTED PERIMETER FULL = F(DEFINING DIMENSION)
    ---------------------------------------------

      0.0        6.3053198-0.3333318 0.0195180

    Q/QFULL = F(A/AFULL)
    --------------------

     -0.0135260 0.7131196 0.0        0.3011928

    A/AFULL = F(DEPTH/DEFINING DIMENSION)
    -------------------------------------

      0.0        0.1876599 0.6815827 0.1307539

    DEPTH/DEFINING DIMENSION = F(A/AFULL)
    -------------------------------------

      0.0470740 1.5077095 0.0        -0.5573937

    WETTED PERIMETER/WETTED PERIMETER FULL = F(DEPTH/DEFINING DIMENSION)
    --------------------------------------------------------------------

      0.0704999 0.9299996-0.0058700 0.0058000

    MANNING'S N = F(DEPTH/DEFINING DIMENSION)
    -----------------------------------------

      0.0330000 0.0        0.0        0.0
```

```
LAND SURFACE DATA FOR STORM RUNOFF -- UNITS OF SLOPE ARE FT/FT, AREA IS ACRES
                                                                                                                     CESAM12-LTSTM
  NODE     STORM          DATA FOR AREA 1                             DATA FOR AREA 2                            DATA FOR AREA 3
  NO.       REF  CODE  AREA    SLOPE  LENGTH     N   CODE  AREA    SLOPE  LENGTH     N   CODE  AREA    SLOPE  LENGTH     N   FLOW
                                                                                                                            RATIO
-------- ----- ----------------------------------- ----------------------------------- ----------------------------------- -----
N1W15001        M1   38.57  0.0050  1350.0  0.017          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15002        M1   26.58  0.0050   400.0  0.017   R1    8.61  0.0050   150.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15003        M1   21.97  0.0050   300.0  0.017   R1   26.50  0.0050   550.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15004        M1   18.78  0.0050   560.0  0.017          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15005        M1   39.34  0.0050  1200.0  0.017   R1    3.67  0.0050   300.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15006        M1   33.80  0.0050  1168.0  0.017   R1    7.40  0.0050   375.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15007        M1   10.39  0.0010   375.0  0.017   R1   11.29  0.0010   550.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15008        M1   69.30  0.0050   750.0  0.017   R1   50.73  0.0050  1000.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15009        M1    7.60  0.0050   800.0  0.017   R1   19.28  0.0050   600.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15010        M1   39.40  0.0030   500.0  0.017          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15011        R1   13.87  0.0050   645.0  0.033          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15012        R1   12.00  0.0010   400.0  0.033          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15013              0.0   0.0000     0.0  0.000          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15014        M1   20.78  0.0010   820.0  0.017   R1   15.90  0.0010   600.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15015        M1   30.24  0.0010  1250.0  0.017   R1   16.10  0.0010   380.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15016        M1    8.27  0.0010   300.0  0.017   R1   13.40  0.0010   350.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15017              0.0   0.0000     0.0  0.000          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15018        M1   14.70  0.0010   620.0  0.017   R1  100.00  0.0010   600.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15019        M1    7.10  0.0010   185.0  0.017   R1   22.40  0.0010   750.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15020              0.0   0.0000     0.0  0.000          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15021        M1  136.50  0.0030  1000.0  0.017   R1   37.80  0.0030   150.0  0.033          0.0  0.0000     0.0  0.000 0.000
N1W15022              0.0   0.0000     0.0  0.000          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15023              0.0   0.0000     0.0  0.000          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000
N1W15024              0.0   0.0000     0.0  0.000          0.0  0.0000     0.0  0.000          0.0  0.0000     0.0  0.000 0.000

TOTAL AREA CONTRIBUTING TO STORM RUNOFF -   886.258 ACRES

NODE INPUT DATA
                                                                                                           CESAM11-LTNDE
  NODE       LID     TYPE        COORDINATES          FLAG       OUTFALL      DIVERTED     MANHOLE     GROUNDWATER
  NO.     ELEVATION             N            E      ELEVATION    HGL EL       TO NODE    VOL (CUFT)       ELEV
------------------------------------------------------------------------------------------------------------------
N1W15001    407.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15002    402.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15003    401.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15004    402.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15005    401.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15006    399.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15007    398.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15008    398.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15009    398.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15010    399.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15011    398.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15012    399.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15013    395.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15014    395.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15015    393.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15016    392.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15017    391.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15018    392.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15019    389.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15020    388.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15021    386.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15022    385.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15023    385.00             0.0         0.0         0.0         0.0            0          0.            0.0
N1W15024    385.00             0.0         0.0         0.0       382.25           0          0.            0.0
```

Reproduced from
best available copy.

64

```
GUTTER DATA
                                                                                                              CESAM11-LTGUT
   NODE    ORDER   SHAPE    GUTTER   GUTTER     SHAPE    GUTTER   GUTTER     SHAPE    GUTTER   GUTTER
   NO.     CODE    CODE 1   SLOPE    LENGTH     CODE 2   SLOPE    LENGTH     CODE 3   SLOPE    LENGTH
---------  -----   -------------------------    -------------------------    -------------------------
N1W15001     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15002     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15003     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15004     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15005     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15006     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15007     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15008     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15009     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15010     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15011     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15012     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15013     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15014     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15015     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15016     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15017     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15018     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15019     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15020     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15021     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15022     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15023     0              0.0000    0.                 0.0000    0.                 0.0000    0.
N1W15024     0              0.0000    0.                 0.0000    0.                 0.0000    0.

AREA AND CODE (WHICH REFERS TO POPULATION DENSITIES) FOR SANITARY FLOW DETERMINATION
                                                                                                              CESAM12-LTSAN
   NODE    CODE   AREA    CODE   AREA    CODE   AREA    POINT     REDUCED FLOW
   NO.      1      1       2      2       3      3      SOURCE       RATIO
-------------------------------------------------------------------------------
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000
N1W15001          0.0           0.0           0.0     0.0000       0.000

TOTAL AREA CONTRIBUTING TO SANITARY FLOWS -     0.0    ACRES
```

PIPE OF CONDUIT DATA

CESAM11-LTCND

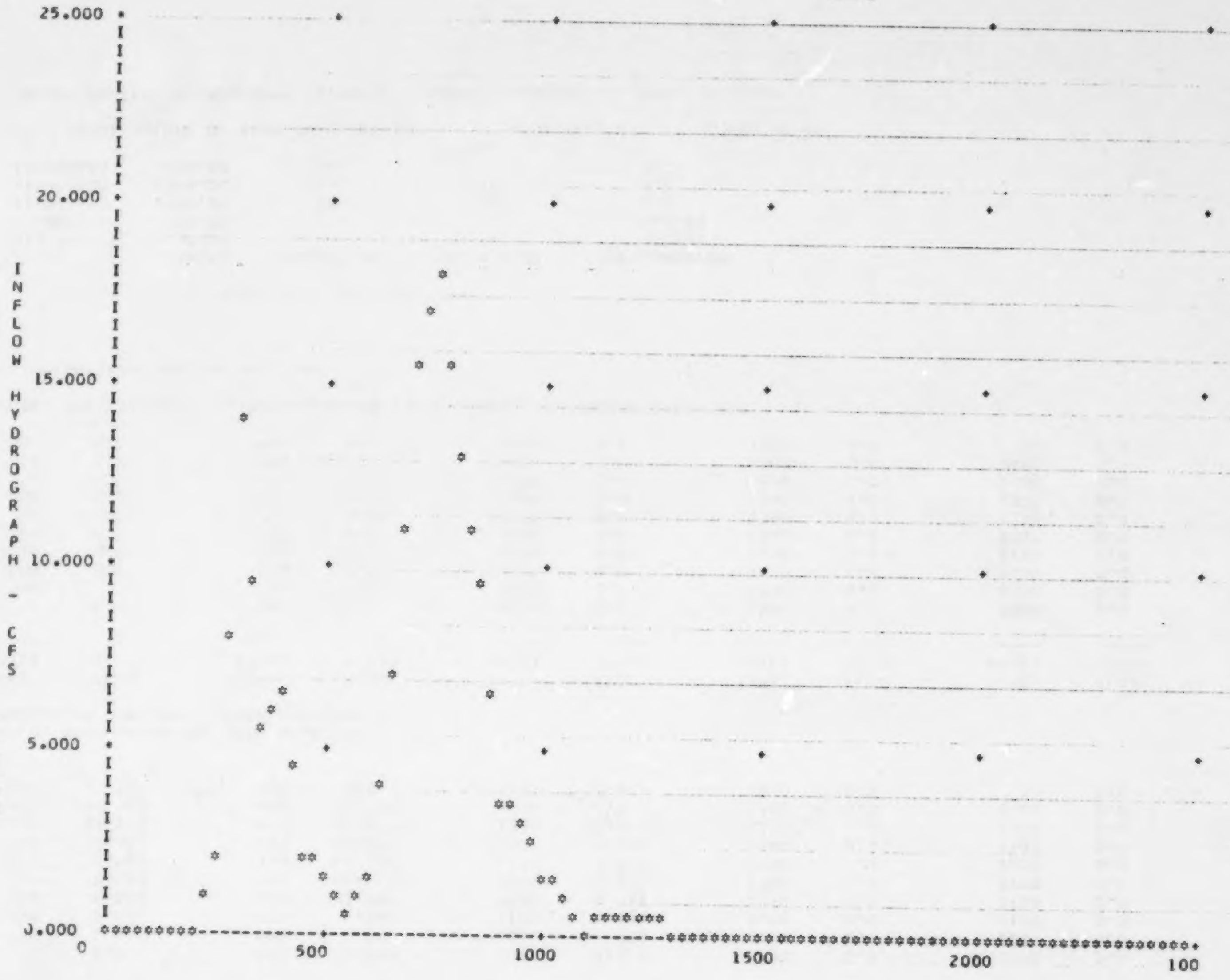
PIPE NO.	UPSTREAM NODE	UPSTREAM INVERT EL	DOWNSTREAM NODE	DOWNSTREAM INVERT EL	LENGTH (FT)	SIZE (IN)	MANNING'S N	INFIL CODE	SHAPE CODE	SLOPE FT/FT	C FULL (CFS)
211000010	N1W15001	357.85	N1W15002	356.00	1230.0	42.0	0.013			0.0015	35.02
211000020	N1W15002	356.00	N1W15003	354.58	1420.0	48.0	0.013			0.0010	45.43
211000030	N1W15003	354.58	N1W15004	392.98	1000.0	48.0	0.013			0.0016	57.45
211000040	N1W15004	392.58	N1W15005	390.98	1000.0	48.0	0.013			0.0016	57.45
211000050	N1W15005	390.98	N1W15006	389.16	700.0	54.0	0.013			0.0026	100.27
211000060	N1W15006	389.16	N1W15007	388.25	350.0	54.0	0.013			0.0026	100.27
211000070	N1W15008	391.06	N1W15009	390.12	450.0	54.0	0.013			0.0020	86.97
211000080	N1W15009	390.12	N1W15010	388.75	700.0	54.0	0.013			0.0020	86.99
211000090	N1W15010	388.75	N1W15011	388.15	600.0	60.0	0.013			0.0010	82.37
211000100	N1W15011	388.15	N1W15012	387.45	700.0	60.0	0.013			0.0010	82.36
211000110	N1W15012	387.45	N1W15013	387.25	200.0	60.0	0.013			0.0010	82.35
211000120	N1W15013	387.25	N1W15007	386.50	750.0	60.0	0.013			0.0010	82.36
211000130	N1W15007	386.50	N1W15014	384.86	1250.0	108.0	0.033	ZZ	T3	0.0013	824.05
211000140	N1W15014	384.86	N1W15015	383.16	1300.0	109.0	0.033	ZZ	T3	0.0013	822.65
211000150	N1W15015	383.16	N1W15016	382.79	280.0	109.0	0.033	ZZ	T3	0.0013	827.10
211000160	N1W15016	382.79	N1W15017	382.44	270.0	108.0	0.033	ZZ	T3	0.0013	818.89
211000170	N1W15017	382.44	N1W15018	382.11	360.0	84.0	0.033	ZZ	T2	0.0009	583.69
211000180	N1W15018	382.11	N1W15019	380.72	1575.0	84.0	0.033	ZZ	T2	0.0009	572.63
211000190	N1W15019	380.72	N1W15020	380.63	105.0	78.0	0.013	ZZ		0.0009	153.57
211000200	N1W15020	380.63	N1W15021	379.52	1260.0	84.0	0.033	ZZ	T2	0.0009	572.17
211000210	N1W15021	379.52	N1W15022	378.29	1400.0	84.0	0.033	ZZ	T2	0.0009	571.36
211000220	N1W15022	378.29	N1W15023	378.19	120.0	66.0	0.013	ZZ		0.0008	96.87
211000230	N1W15022	378.29	N1W15023	378.19	120.0	66.0	0.013	ZZ		0.0008	96.87
211000240	N1W15023	378.19	N1W15024	377.75	600.0	60.0	0.033	ZZ	T1	0.0007	258.70

Reproduced from best available copy.

```
INFLOW HYDROGRAPH FOR NODE N1W15002
HYDROGRAPH CONTAINS - OVERLAND FLOW

 TIME      FLOW         TIME      FLOW         TIME      FLOW         TIME      FLOW         TIME      FLOW
 (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)
 -----     -----        -----     -----        -----     -----        -----     -----        -----     -----

     0     0.040          500     0.621         1000     1.200         1500     0.040         2000     0.040
    30     0.040          530     0.040         1030     1.272         1530     0.040         2030     0.040
   100     0.043          600     4.409         1100     0.040         1600     0.040         2100     0.040
   130     0.048          630    24.681         1130     0.691         1630     0.040         2130     0.040
   200     0.099          700    15.645         1200     1.282         1700     0.040         2200     0.040
   230     9.043          730    35.313         1230     1.272         1730     0.040         2230     0.040
   300    24.551          800    24.743         1300     0.040         1800     0.040         2300     0.040
   330    15.803          830     3.936         1330     0.040         1830     0.040         2330     0.040
   400     2.160          900     7.666         1400     0.040         1900     0.040         2400     0.040
   430     6.080          930     4.967         1430     0.040         1930     0.040           30     0.040

INFLOW HYDROGRAPH FOR NODE N1W15007
HYDROGRAPH CONTAINS - OVERLAND FLOW

 TIME      FLOW         TIME      FLOW         TIME      FLOW         TIME      FLOW         TIME      FLOW
 (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)
 -----     -----        -----     -----        -----     -----        -----     -----        -----     -----

     0     0.049          500     1.746         1000     1.701         1500     0.049         2000     0.049
    30     0.049          530     0.272         1030     1.073         1530     0.049         2030     0.049
   100     0.050          600     1.344         1100     0.175         1600     0.049         2100     0.049
   130     0.051          630     6.802         1130     0.370         1630     0.049         2130     0.049
   200     0.061          700    15.437         1200     0.526         1700     0.049         2200     0.049
   230     1.780          730    18.102         1230     0.601         1730     0.049         2230     0.049
   300    13.764          800    12.881         1300     0.086         1800     0.049         2300     0.049
   330     5.326          830     9.584         1330     0.049         1830     0.049         2330     0.049
   400     6.553          900     3.672         1400     0.049         1900     0.049         2400     0.049
   430     2.119          930     2.852         1430     0.049         1930     0.049           30     0.049

INFLOW HYDROGRAPH FOR NODE N1W15008
HYDROGRAPH CONTAINS - OVERLAND FLOW

 TIME      FLOW         TIME      FLOW         TIME      FLOW         TIME      FLOW         TIME      FLOW
 (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)        (MIL)     (CFS)
 -----     -----        -----     -----        -----     -----        -----     -----        -----     -----

     0     0.0            500     9.074         1000     8.447         1500     0.0           2000     0.0
    30     0.0            530     0.685         1030     5.217         1530     0.0           2030     0.0
   100     0.004          600     7.839         1100     0.380         1600     0.0           2100     0.0
   130     0.011          630    43.502         1130     1.685         1630     0.0           2130     0.0
   200     0.094          700    90.922         1200     2.780         1700     0.0           2200     0.0
   230    12.645          730   101.261         1230     3.272         1730     0.0           2230     0.0
   300    91.368          800    66.347         1300     0.178         1800     0.0           2300     0.0
   330    23.357          830    54.721         1330     0.0           1830     0.0           2330     0.0
   400    33.829          900    15.514         1400     0.0           1900     0.0           2400     0.0
   430    10.059          930    15.461         1430     0.0           1930     0.0             30     0.0
```

```
                                                                                                   CESAM16-PROHD
 INFLOW HYDROGRAPH FOR NODE N1W15018
 HYDROGRAPH CONTAINS - OVERLAND FLOW

  TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW
  (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)
  -----     -----       -----     -----       -----     -----       -----     -----       -----     -----

     0      0.0          500      9.573       1000      9.373       1500      0.0         2000      0.0
    30      0.0          530      2.054       1030      6.058       1530      0.0         2030      0.0
   100      0.001        600      4.522       1100      1.131       1600      0.0         2100      0.0
   130      0.002        630     21.811       1130      1.518       1630      0.0         2130      0.0
   200      0.010        700     66.608       1200      1.815       1700      0.0         2200      0.0
   230      1.522        730     97.108       1230      2.017       1730      0.0         2230      0.0
   300     35.311        800     71.255       1300      0.135       1800      0.0         2300      0.0
   330     47.170        830     51.897       1330      0.0         1830      0.0         2330      0.0
   400     30.012        900     24.782       1400      0.0         1900      0.0         2400      0.0
   430     15.724        930     15.141       1430      0.0         1930      0.0           30      0.0

 INFLOW HYDROGRAPH FOR NODE N1W15022
 HYDROGRAPH CONTAINS - OVERLAND FLOW

  TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW
  (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)
  -----     -----       -----     -----       -----     -----       -----     -----       -----     -----

     0      0.0          500      0.0         1000      0.0         1500      0.0         2000      0.0
    30      0.0          530      0.0         1030      0.0         1530      0.0         2030      0.0
   100      0.0          600      0.0         1100      0.0         1600      0.0         2100      0.0
   130      0.0          630      0.0         1130      0.0         1630      0.0         2130      0.0
   200      0.0          700      0.0         1200      0.0         1700      0.0         2200      0.0
   230      0.0          730      0.0         1230      0.0         1730      0.0         2230      0.0
   300      0.0          800      0.0         1300      0.0         1800      0.0         2300      0.0
   330      0.0          830      0.0         1330      0.0         1830      0.0         2330      0.0
   400      0.0          900      0.0         1400      0.0         1900      0.0         2400      0.0
   430      0.0          930      0.0         1430      0.0         1930      0.0           30      0.0
*PRINT INFILTRATION  211000020 211000070 211000130 211000180 211000220

BEGINNING INFILTRATION ANALYSIS



           **** PIPE INFILTRATION ****

   PIPE          LENGTH      CONDITION      SHAPE CODE      INFILTRATION                              CESAM17-SAINF
 211000020      1420.00                                           0.0527
 211000070       450.00                                           0.0188
 211000130      1250.00         ZZ              T3                0.0
 211000180      1575.00         ZZ              T2                0.0
 211000220       120.00         ZZ                                0.0
                                                                  0.0
       TOTAL VOLUME OF PIPE INFILTRATION -       6436.46CU FT      0.1478 AC FT
*PRINT ROUTED  HYDROGRAPHS 21105002 21105007 21105008 21105018 21105022




         ****  PIPE INFILTRATION  ****
```

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM   NODE 21105007   CESAM16-PRPLT

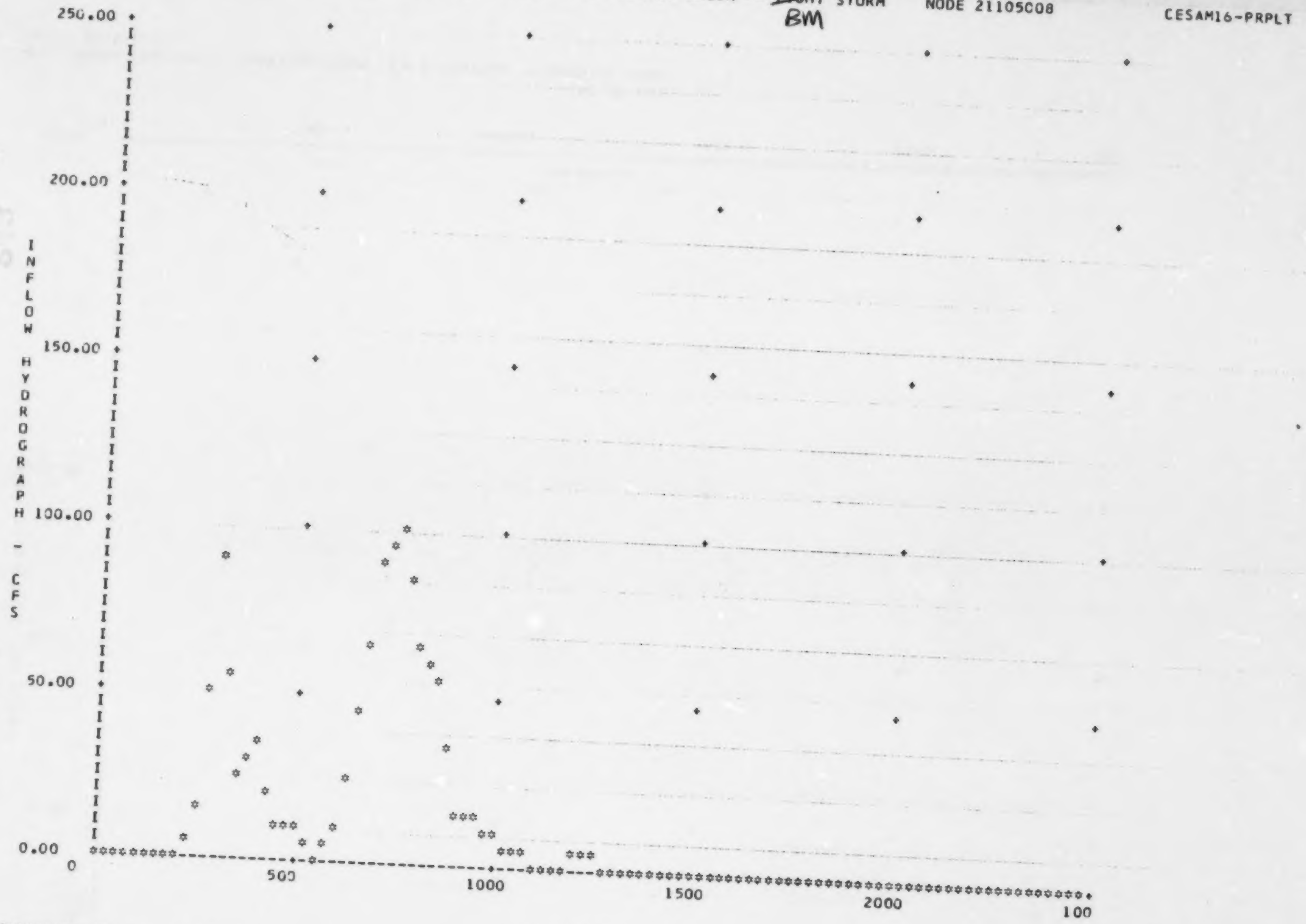


TIME OF DAY

HYDROGRAPH CONTAINS - OVERLAND FLOW
BASIN ROOSEVELT

241

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM NODE 21105C08 CESAM16-PRPLT



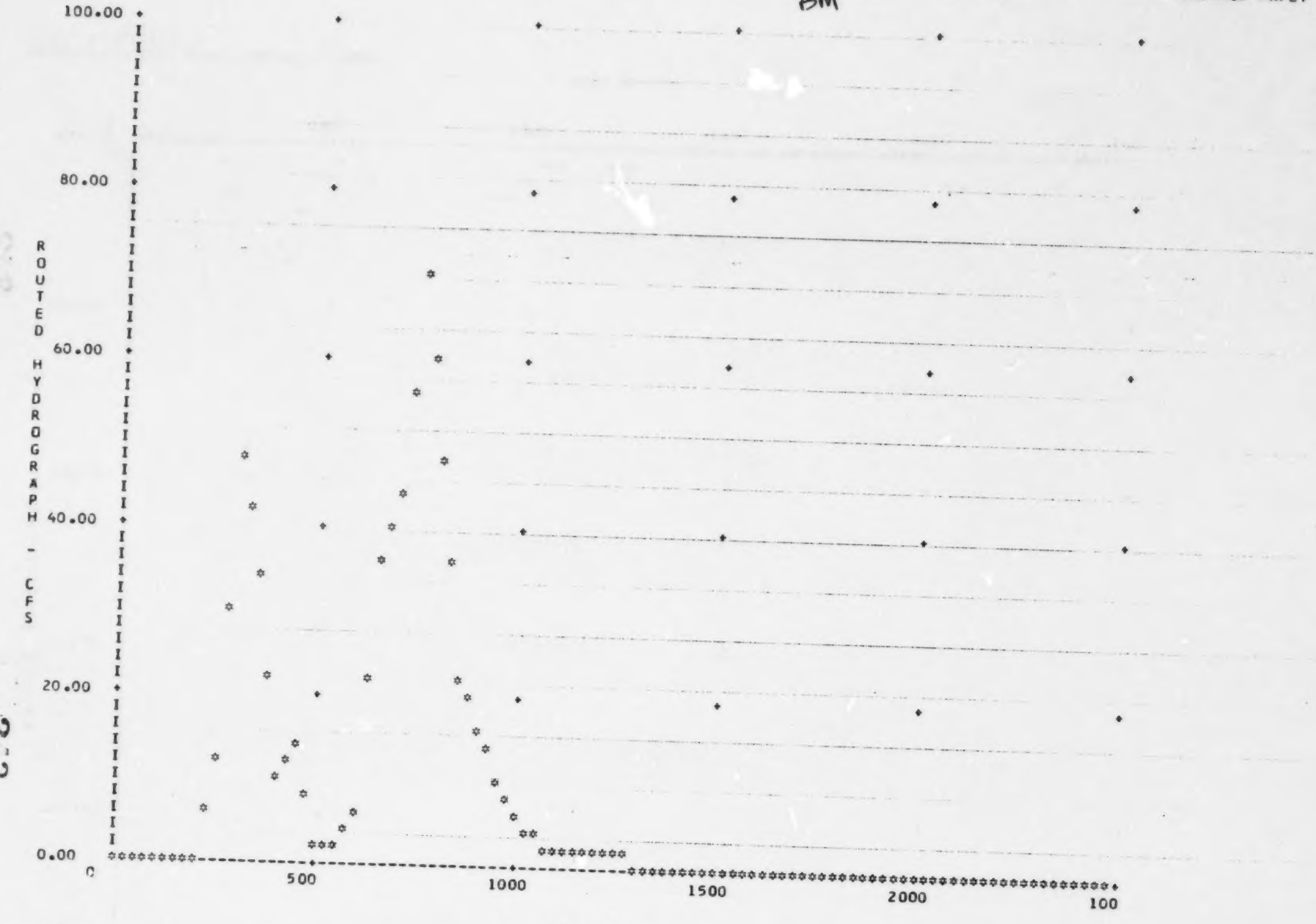
HYDROGRAPH CONTAINS - OVERLAND FLOW
BASIN ROOSEVELT

TIME OF DAY

242

67

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM NODE 21105002 CESAM16-PRPLT



HYDROGRAPH CONTAINS - OVERLAND FLOW INFILTRATION KINEMATIC WAVE
BASIN ROOSEVELT

BM

```
ROUTED HYDROGRAPH FOR NODE N1W15002                                                                        CESAM16-PRRHD
HYDROGRAPH CONTAINS - OVERLAND FLOW  INFILTRATION  KINEMATIC WAVE

 TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW
 (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)
 -----    -----       -----    -----       -----    -----       -----    -----       -----    -----

    0     0.040         500    2.991        1000    5.618        1500    0.040        2000    0.040
   30     0.040         530    2.235        1030    3.352        1530    0.040        2030    0.040
  100     0.043         600    6.033        1100    1.222        1600    0.040        2100    0.040
  130     0.050         630   36.028        1130    1.222        1630    0.040        2130    0.040
  200     0.112         700   44.328        1200    2.563        1700    0.040        2200    0.040
  230    11.349         730   69.576        1230    2.594        1730    0.040        2230    0.040
  300    48.561         800   48.899        1300    0.868        1800    0.040        2300    0.040
  330    34.769         830   21.675        1330    0.055        1830    0.040        2330    0.040
  400     9.795         900   16.849        1400    0.040        1900    0.040        2400    0.040
  430    13.788         930    9.226        1430    0.040        1930    0.040          30    0.040

ROUTED HYDROGRAPH FOR NODE N1W15007
HYDROGRAPH CONTAINS - OVERLAND FLOW  INFILTRATION  KINEMATIC WAVE

 TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW
 (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)
 -----    -----       -----    -----       -----    -----       -----    -----       -----    -----

    0     0.363         500  100.906        1000  103.051        1500    0.370        2000    0.352
   30     0.363         530   90.886        1030   94.347        1530    0.355        2030    0.372
  100     0.368         600   13.836        1100    4.763        1600    0.365        2100    0.357
  130     0.388         630  143.576        1130    8.109        1630    0.372        2130    0.369
  200     0.511         700  326.810        1200    7.456        1700    0.347        2200    0.360
  230    30.369         730  393.488        1230   14.477        1730    0.383        2230    0.366
  300   274.652         800  275.923        1300    7.909        1800    0.343        2300    0.361
  330   236.972         830  237.401        1330    2.049        1830    0.383        2330    0.365
  400   198.396         900  187.264        1400    0.581        1900    0.347        2400    0.362
  430   117.975         930  116.002        1430    0.365        1930    0.377          30    0.364

ROUTED HYDROGRAPH FOR NODE N1W15008
HYDROGRAPH CONTAINS - OVERLAND FLOW  INFILTRATION  KINEMATIC WAVE

 TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW
 (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)
 -----    -----       -----    -----       -----    -----       -----    -----       -----    -----

    0     0.0           500    9.074        1000    8.447        1500    0.0          2000    0.0
   30     0.0           530    0.685        1030    5.217        1530    0.0          2030    0.0
  100     0.004         600    7.839        1100    0.380        1600    0.0          2100    0.0
  130     0.011         630   43.502        1130    1.685        1630    0.0          2130    0.0
  200     0.084         700   90.922        1200    2.780        1700    0.0          2200    0.0
  230    12.645         730  101.261        1230    3.272        1730    0.0          2230    0.0
  300    91.368         800   66.347        1300    0.178        1800    0.0          2300    0.0
  330    23.357         830   54.721        1330    0.0          1830    0.0          2330    0.0
  400    33.829         900   15.514        1400    0.0          1900    0.0          2400    0.0
  430    10.059         930   15.461        1430    0.0          1930    0.0            30    0.0
```

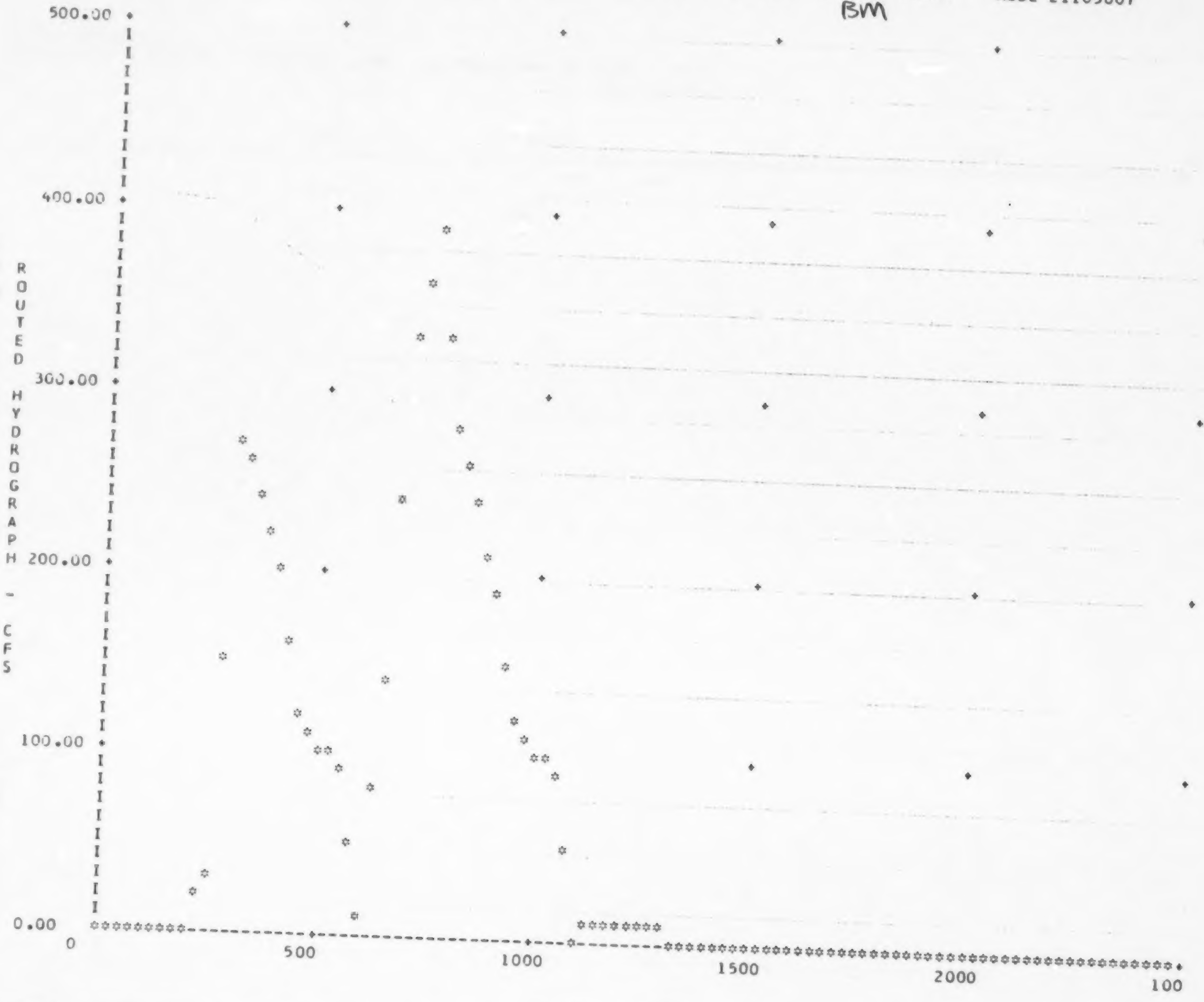
BM

```
ROUTED HYDROGRAPH FOR NODE N1W15018
HYDROGRAPH CONTAINS - OVERLAND FLOW  INFILTRATION  KINEMATIC WAVE
 TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW
 (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)
 -----     -----       -----     -----       -----     -----       -----     -----       -----     -----

     0     0.363         500   137.148        1000   126.276        1500     0.734        2000     0.335
    30     0.363         530    96.605        1030   108.731        1530     0.110        2030     0.383
   100     0.366         600    75.858        1100    71.837        1600     0.492        2100     0.350
   130     0.378         630   105.896        1130    12.681        1630     0.325        2130     0.371
   200     0.452         700   359.306        1200     4.748        1700     0.348        2200     0.359
   230    14.318         730   572.085        1230    18.305        1730     0.407        2230     0.365
   300   205.597         800   484.441        1300    12.634        1800     0.310        2300     0.363
   330   377.490         830   354.615        1330     7.577        1830     0.417        2330     0.363
   400   287.860         900   263.149        1400     1.660        1900     0.316        2400     0.364
   430   184.877         930   191.061        1430     0.0          1930     0.401          30     0.363

ROUTED HYDROGRAPH FOR NODE N1W15022
HYDROGRAPH CONTAINS - OVERLAND FLOW  INFILTRATION  KINEMATIC WAVE
 TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW
 (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)
 -----     -----       -----     -----       -----     -----       -----     -----       -----     -----

     0     0.363         500   174.986        1000   192.233        1500     2.493        2000     0.377
    30     0.363         530   137.913        1030   135.488        1530     0.072        2030     0.351
   100     0.365         600   101.533        1100   102.758        1600     0.308        2100     0.373
   130     0.372         630   140.281        1130    70.238        1630     0.493        2130     0.356
   200     0.410         700   336.272        1200    36.534        1700     0.247        2200     0.368
   230     7.443         730   645.644        1230    12.385        1730     0.440        2230     0.361
   300   154.813         800   668.899        1300    12.306        1800     0.326        2300     0.364
   330   377.685         830   555.343        1330    16.403        1830     0.375        2330     0.363
   400   399.001         900   355.153        1400    11.727        1900     0.368        2400     0.363
   430   285.426         930   259.879        1430     5.051        1930     0.353          30     0.364

*PRINT MAXIMUM HGLS  21105002 21105007 21105008 21105018 21105022
```

```
MAXIMUM HYDRAULIC GRADE LINE

   NODE       TIME      DEPTH     HGL ELEV                                                    CESAM16-PRMXH
              (MIL)     (FT)        (FT)
  ----       -----                  -----    --------
N1W15002       730      15.53      411.53
N1W15007       730       7.46      393.96
N1W15008       730      14.09      405.08
N1W15018       730       6.99      389.10
N1W15022       800       8.49      386.78

*PRINT SURCHARGE  21105002 21105007 21105008 21105018 21105022


SURCHARGED MANHOLES

   NODE   TIME OF INITIAL       HGL   TIME OF MAXIMUM        HGL  TOTAL TIME SURCHARGED       CESAM16-PRSCH
             SURCHARGE (MIL)          ELEV  SURCHARGE (MIL)       ELEV      (HR AND MIN)
-------  ------------------------    ------------------------     --------------------
N1W15002         300           404.47        730          411.53          200
N1W15008         300           400.10        730          405.08          230
N1W15022         330           384.02        800          386.78          230
*PRINT VOLUMES  21105002 21105007 21105008 21105018 21105022


TOTAL VOLUMES OF FLOW
               INFLOW HYDROGRAPH                     ROUTED HYDROGRAPH
  NODE        CUBIC FEET     ACRE FEET          CUBIC FEET       ACRE FEET                    CESAM17-PRVOL
N1W15002      335954.06        7.7124           374613.50          8.5999
N1W15007      194691.63        4.4695          5199581.00        119.3660
N1W15008     1077553.00       24.7372               0.0             0.0
N1W15018      929786.00       21.3449          6421680.00        147.4215
N1W15022          0.0          0.0             9371381.00        215.1373
*PRINT FLAG ELEVATIONS  21105002 21105007 21105008 21105018 21105022


LIST OF NODES AT WHICH THE HGL EXCEEDS THE FLAG ELEVATION OR MANHOLE LID ELEVATION
 NODE      CRITICAL   EXCEEDED   MANHOLE LID   EXCEEDED   MAXIMUM HGL   MILITARY                CESAM15-PRFLG
  NO.     ELEVATION    (TIME)     ELEVATION     (TIME)     ELEVATION      TIME
 -----   -------------------     ---------------------     ----------------------
N1W15002     0.0         0          402.00        300        411.53        730
N1W15008     0.0         0          398.00        300        405.08        730
N1W15022     0.0         0          385.00        730        386.78        800
*PRINT SUMMARY  21105002 21105007 21105008 21105018 21105022

SURCHARGED MANHOLES
```

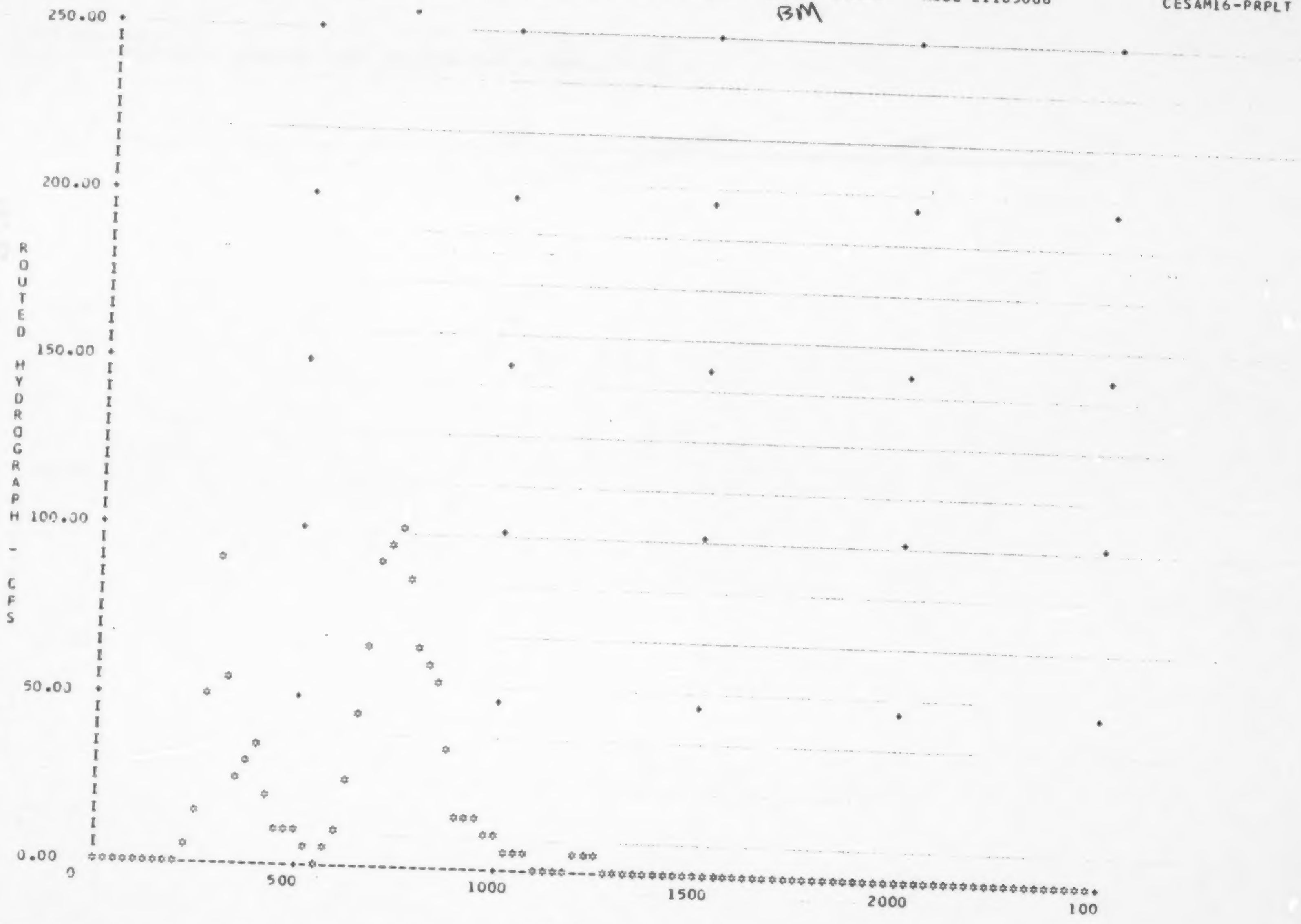
```
SUMMARY OF CRITICAL FLOW DATA BY PIPE
                                                                                                   CESAM16-PRSUM
FROM       TO          PIPE      Q-FULL       MAX-FLOW      UPSTREAM      MAX        MAX        UPSTREAM
MANHOLE    MANHOLE     SIZE      (CFS)        (CFS)         INVERT        HGL        DEPTH      FLAG
--------------------------------------------------------------------------------------------------------------
N1W15002   N1W15003    48.0      45.43  **     69.58        396.00        411.53     186.36     402.00
N1W15007   N1W15014    ****     824.05        393.49        386.50        393.96      89.52     398.00
N1W15008   N1W15009    54.0      86.97  **    101.26        391.00        405.08     168.96     398.00
N1W15C18   N1W15019    84.0     572.63  **    572.08        382.11        389.10      83.88     392.00
N1W15022   N1W15023    66.0      96.87  **    668.90        378.29        386.78     101.88     385.00
N1W15022   N1W15023    66.0      96.87  **    668.90        378.29        386.78     101.88     385.00
*PRINT AVERAGE  21105002 21105007 21105008 21105018 21105022


                                                                                                   PAGE   1
                                      MANHOLE FLOW RATE                                            CESAM35    PRFLO
                                   IN CUBIC FEET PER SECOND
                 MANHOLE
                 NUMBER               MINIMUM RATE            AVERAGE RATE            MAXIMUM RATE
                                        OF FLOW                 OF FLOW                 OF FLOW
               ------------------------------------------------------------------------------------
                 N1W15001                0.0                     4.16                   33.31
                 N1W15002                0.04                    7.90                   69.58
                 N1W15003                0.05                   13.08                  106.44
                 N1W15004                0.08                   15.66                  126.35
                 N1W15005                0.10                   20.55                  162.51
                 N1W15006                0.15                   25.31                  195.91
                 N1W15007                0.34                   59.94                  393.49
                 N1W15008                0.0                    11.97                  101.26
                 N1W15009                0.02                   15.99                  122.33
                 N1W15010                0.03                   21.41                  158.06
                 N1W15011                0.03                   24.37                  169.11
                 N1W15012                0.04                   26.50                  179.47
                 N1W15013                0.01                   28.95                  179.48
                 N1W15014                0.20                   64.23                  423.88
                 N1W15015                0.0                    69.11                  460.04
                 N1W15016                0.13                   71.24                  478.32
                 N1W15017                0.17                   71.29                  477.23
                 N1W15018                0.0                    81.68                  572.08
                 N1W15019                0.12                   84.72                  570.68
                 N1W15020                0.03                   84.90                  570.68
                 N1W15021                0.19                  103.37                  690.73
                 N1W15022                0.07                  104.13                  668.90
                 N1W15023                0.17                  105.60                  668.90
                 N1W15024                0.0                   107.32                  668.90
*PRINTER PLOT STORM HYDROGRAPHS 21105002 21105007 21105008 21105018 21105022
```

TEST OF SAM MODEL FOR STORM SEWER -- ROODSEVELT BASIN -- ~~LIGHT~~ BM STORM NODE 21105007 CESAM16-PRPLT



HYDROGRAPH CONTAINS - OVERLAND FLOW INFILTRATION KINEMATIC WAVE
BASIN ROOSEVELT

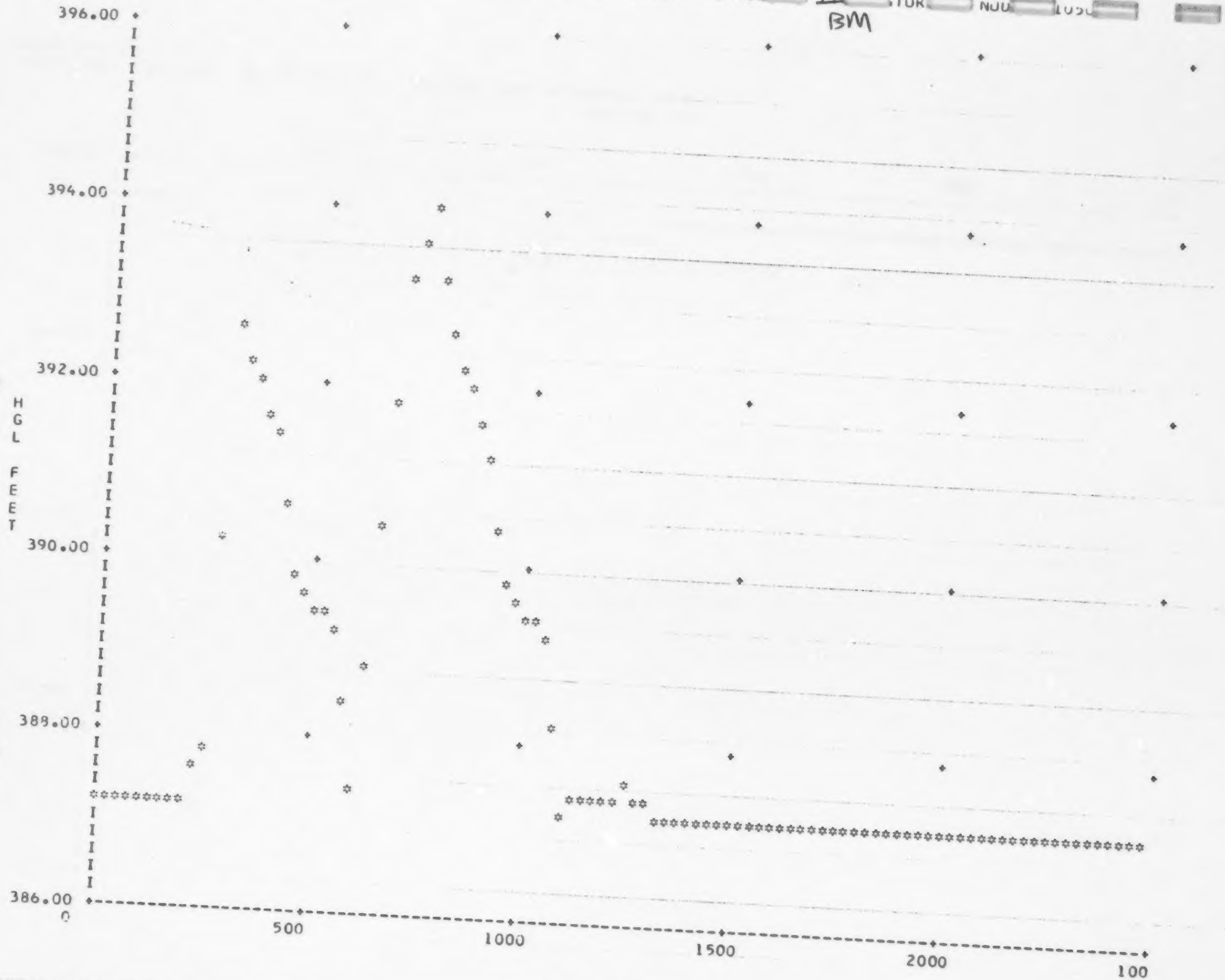
TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM NODE 21105008 CESAM16-PRPLT



HYDROGRAPH CONTAINS - OVERLAND FLOW INFILTRATION KINEMATIC WAVE
BASIN ROOSEVELT

BM

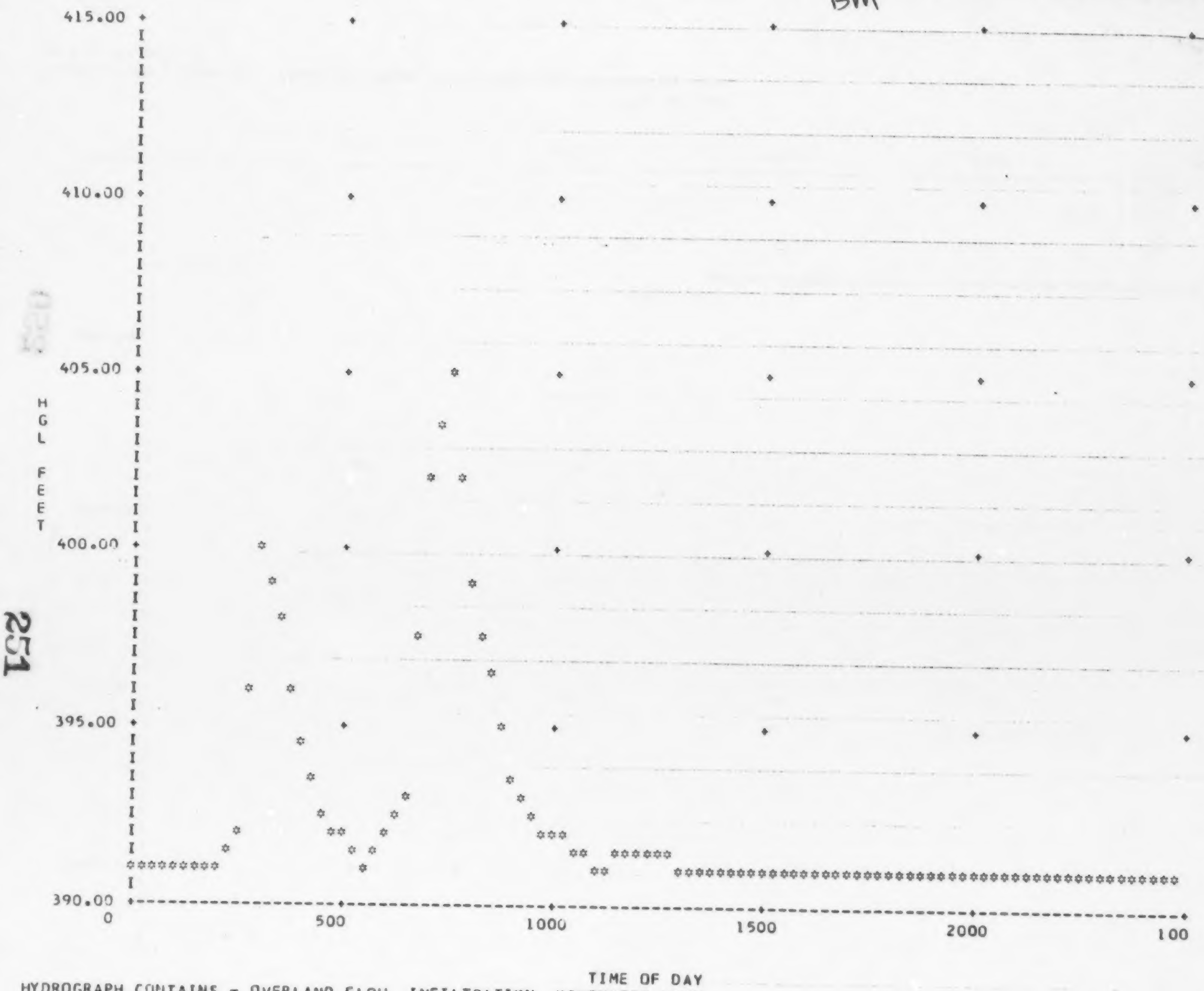
250



HYDROGRAPH CONTAINS - OVERLAND FLOW INFILTRATION KINEMATIC WAVE
BASIN ROOSEVELT

41

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM NODE 21105008 CESAMIG-PRPLT



HYDROGRAPH CONTAINS - OVERLAND FLOW INFILTRATION KINEMATIC WAVE
BASIN ROOSEVELT

#2

SAM (Updated) Model Printouts
CH2M-Hill

For Bimodal (BM) Storm on Roosevelt Basin
Kinematic Wave Routing

NOTE: Storm chosen to include but not exceed:

12-hour 10-year recurrence intensity
6-hour 10-year recurrence intensity
1-hour 10-year recurrence intensity

Date: October 22, 1981

```
BBBBBBBBBBBB         MMM         MMM      HHH         HHH      YYY         YYY      EEEEEEEEEEEEEEE      TTTTTTTTTTTTTTT
BBBBBBBBBBBB         MMM         MMM      HHH         HHH      YYY         YYY      EEEEEEEEEEEEEEE      TTTTTTTTTTTTTTT
BBBBBBBBBBBB         MMM         MMM      HHH         HHH      YYY         YYY      EEEEEEEEEEEEEEE      TTTTTTTTTTTTTTT
BBB         BBB      MMMMMM   MMMMMM      HHH         HHH      YYY         YYY      EEE                        TTT
BBB         BBB      MMMMMM   MMMMMM      HHH         HHH      YYY         YYY      EEE                        TTT
BBB         BBB      MMMMMM   MMMMMM      HHH         HHH      YYY         YYY      EEE                        TTT
BBB         BBB      MMM   MMM   MMM      HHH         HHH         YYY   YYY         EEE                        TTT
BBB         BBB      MMM   MMM   MMM      HHH         HHH         YYY   YYY         EEE                        TTT
BBB         BBB      MMM   MMM   MMM      HHH         HHH         YYY   YYY         EEE                        TTT
BBBBBBBBBBBB         MMM         MMM      HHHHHHHHHHHHHHH            YYY            EEEEEEEEEEEE               TTT
BBBBBBBBBBBB         MMM         MMM      HHHHHHHHHHHHHHH            YYY            EEEEEEEEEEEE               TTT
BBBBBBBBBBBB         MMM         MMM      HHHHHHHHHHHHHHH            YYY            EEEEEEEEEEEE               TTT
BBB         BBB      MMM         MMM      HHH         HHH            YYY            EEE                        TTT
BBB         BBB      MMM         MMM      HHH         HHH            YYY            EEE                        TTT
BBB         BBB      MMM         MMM      HHH         HHH            YYY            EEE                        TTT
BBB         BBB      MMM         MMM      HHH         HHH            YYY            EEE                        TTT
BBB         BBB      MMM         MMM      HHH         HHH            YYY            EEE                        TTT
BBB         BBB      MMM         MMM      HHH         HHH            YYY            EEE                        TTT
BBBBBBBBBBBB         MMM         MMM      HHH         HHH            YYY            EEEEEEEEEEEEEEE            TTT
BBBBBBBBBBBB         MMM         MMM      HHH         HHH            YYY            EEEEEEEEEEEEEEE            TTT
BBBBBBBBBBBB         MMM         MMM      HHH         HHH            YYY            EEEEEEEEEEEEEEE            TTT


   OOOOOOOOO         UUU         UUU      TTTTTTTTTTTTTTT
   OOOOOOOOO         UUU         UUU      TTTTTTTTTTTTTTT
   OOOOOOOOO         UUU         UUU      TTTTTTTTTTTTTTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
OOO         OOO      UUU         UUU            TTT
   OOOOOOOOO         UUUUUUUUUUUUUUU            TTT
   OOOOOOOOO         UUUUUUUUUUUUUUU            TTT
   OOOOOOOOO         UUUUUUUUUUUUUUU            TTT
```

3M
Bimodal

HYETOGRAPH FILED

```
 *START* User CVO B.PATTON [133,6726]  Job  BMHYET Seq. 308 Date 08-Dec-81 10:18:54 Monitor CH2M HILL KL10/603A.VM B *START*
File: DSKC:BMHYET.OUT<155>[133,6726,LANCOG] Created: 08-Dec-81 08:47:00 Printed: 08-Dec-81 10:19:01
QUEUE Switches:  /FILE:FORT /COPIES:1 /SPACING:1 /LIMIT:1432 /FORMS:NORMAL
```

253

73

```
*********************************************
*                                           *
*                   S A M                   *
*                   -----                   *
*                                           *
*          WASTEWATER COLLECTION            *
*          SYSTEM ANALYSIS MODEL            *
*                                           *
*             CH2M HILL, INC.               *
*       1600 SW WESTERN BOULEVARD           *
*          CORVALLIS, OREGON                *
*                                           *
*           WESLEY G. O'NEEL                *
*            ALLEN L. DAVIS                 *
*         KENNFTH W. VANDUSEN               *
*                                           *
*              VERSION 2.18                 *
*              OCT.22, 1981                 *
*                                           *
*          RUN ON  8-Dec-81 08:47           *
*                                           *
*********************************************


IN  UNIT  12 DSK:OUTPUT.DAT[000133,006726,LANCOG]

OUT UNIT  13 DSK:BNHYET.OUT[000133,006726,LANCOG]
```

ROL AND

TEST OF SAM MODEL FOR STORM SEWFR -- ROOSEVFLT BASIN -- ~~LIGHT~~ BM STORM.

```
DEFAULT VALUES AND CODES FOR...

HYDROGRAPH TIME       PAN        MANNING'S N     CODF FOR      CODF FOR        CODF FOR       CODF FOR
   INCREMENT      EVAPORATION     CIRCULAR        STORM      STORM RUNOFF    POPULATION        PIPE
     (MIN)          (IN/DAY)       SECTION      REFERENCE     CONDITIONS       DENSITY     INFILTRATION
-----------------------------------------------------------------------------------------------------
     30.00            0.10         0.0130          BM            R1              AA             II

DAYS OF POLLUTANT BUILD-UP AT BEGINNING OF ANALYSIS -     0.02


PIPE INFILTRATION CODES AND RATES IN GPD FOR 12 IN. CIRCULAR PIPE

CODF   INFIL         CODE   INFIL         CODF   INFIL         CODF   INFIL         CODF   INFIL
-----------------------------------------------------------------------------------------------
 II    600.0          ZZ     0.0                  0.0                  0.0                  0.0
```

```
HYETOGRAPHS FOR OVERLAND FLOW CALCULATIONS

    STORM          TIME                 RAINFALL
IDFNTIFICATION                          INTENSITY
                   (MIN)                 (IN/HR)
---------------------------------------------------
     BM             0.0                   0.00
                   30.0                   0.05
                   60.0                   0.05
                   90.0                   0.20
                  120.0                   0.35
                  150.0                   0.60
                  180.0                   0.50
                  210.0                   0.30
                  240.0                   0.15
                  270.0                   0.10
                  300.0                   0.00
                  330.0                   0.15
                  360.0                   0.35
                  390.0                   0.65
                  420.0                   0.85
                  450.0                   0.72
                  480.0                   0.52
                  510.0                   0.25
                  540.0                   0.15
                  570.0                   0.10
                  600.0                   0.05
                  630.0                   0.00
                  660.0                   0.05
                  690.0                   0.05
                  720.0                   0.05


                  OPERATION CONTROL
                         FOR
                    CONTROL SYSTEM

ANALYSIS BEGINS:     0  0  0     0HRS
ANALYSIS ENDS:       0  0  0     0HRS
ANALYSIS TIME STEP IS:     0.0 MINUTFS

DEFAULT HANKING'S N  :   .01575
DEFAULT SECTION CODE : [   ]
```

```
DATA TAI TO WEA (SA RY) W **
AVERAGE DOMESTIC FLOW PER CAPITA =  100.00

PEAKING FACTOR CURVE

     CLOCK    PEAKING
      TIME     FACTOR
    --------------------
         0      1.00
         6      1.00
        12      1.00
        18      1.00
        24      1.00

POPULATION CODES AND DENSITIES IN PERSONS PER ACRE

CODE   DENSITY      CODE   DENSITY       CODE   DENSITY       CODE   DENSITY       CODE   DENSITY
---------------------------------------------------------------------------------------------------
AA       0.00


CODES AND TABLE VALUES FOR SOIL AND LAND SURFACE CONDITIONS

CODE       FO          FC          K          FOI        I&D DEPTH    PERCENT    PERCENT
         (IN/HR)     (IN/HR)    (1/MIN)     (IN/HR)        (IN)        FULL     PERVIOUS
------------------------------------------------------------------------------------------
R1        0.50        0.10       0.069        0.21         0.15        25.0       60.0
M1        0.50        0.10       0.069        0.21         0.15        25.0       20.0
```

Max infiltration rate

Infiltration rate at saturation

Decay constant used in Horton's equation

Infiltration rate at beginning of storm

Reproduced from
best available copy.

```
**** SECTION PROPERTIES ****

THE FOLLOWING COEFFICIENTS ARE OF THE FORM-
    Y=C1+C2(X)+C3(X**2)+C4(X**3)


SECTION CODE T1

        TOTAL AREA = F(DEFINING DIMENSION)
        ----------------------------------

            0.000000010.0000000 2.0000000 0.0000000

        WETTED PERIMETER FULL = F(DEFINING DIMENSION)
        ---------------------------------------------

            0.000000019.8036600-5.9979990 0.6663330

        Q/QFULL = F(A/AFULL)
        --------------------

            -0.0147240 0.7060500 0.0000000 0.3093710

        A/AFULL = F(DEPTH/DEFINING DIMENSION)
        -------------------------------------

            0.0000000 0.4999900 0.5000010 0.0000000

        DEPTH/DEFINING DIMENSION = F(A/AFULL)
        -------------------------------------

            0.0183960 1.3031600 0.0000000-0.3224230

        WETTED PERIMETER/WETTED PERIMETER FULL = F(DEPTH/DEFINING DIMENSION)
        --------------------------------------------------------------------

            0.3090000 0.6910000 0.0004000-0.0003000

        MANNING'S N = F(DEPTH/DEFINING DIMENSION)
        -----------------------------------------

            0.0330000 0.0000000 0.0000000 0.0000000


SECTION CODE T2

        TOTAL AREA = F(DEFINING DIMENSION)
        ----------------------------------

            0.000000010.0000000 2.0000000 0.0000000

        WETTED PERIMETER FULL = F(DEFINING DIMENSION)
        ---------------------------------------------

            0.000000012.9005600-1.9999970 0.1428570
```

```
Q[illegible]L =[illegible]/AF[illegible]
--------------------

     0.0000000 0.3430300 1.0655240-0.4085530
A/AFULL = F(DEPTH/DEFINING DIMENSION)
-------------------------------------

     0.0000000 0.4172100 0.5816480 0.0011430
DEPTH/DEFINING DIMENSION = F(A/AFULL)
-------------------------------------

     0.0000000 1.9976300-1.8432340 0.8456080
WETTED PERIMETER/WETTED PERIMETER FULL = F(DEPTH/DEFINING DIMENSION)
--------------------------------------------------------------------

     0.2430000 0.7580000-0.0267000 0.0279000
MANNING'S N = F(DEPTH/DEFINING DIMENSION)
-----------------------------------------

     0.0330000 0.0000000 0.0000000 0.0000000


SECTION CODE T3
        TOTAL AREA = F(DEFINING DIMENSION)
        ----------------------------------

             0.0000000 3.0000000 2.0000000 0.0000000
        WETTED PERIMETER FULL = F(DEFINING DIMENSION)
        ---------------------------------------------

             0.0000000 6.3053200-0.3333320 0.0185180
        Q/QFULL = F(A/AFULL)
        --------------------

            -0.0135260 0.7131200 0.0000000 0.3011930
        A/AFULL = F(DEPTH/DEFINING DIMENSION)
        -------------------------------------

             0.0000000 0.1876600 0.6815830 0.1307540
        DEPTH/DEFINING DIMENSION = F(A/AFULL)
        -------------------------------------

             0.0470740 1.5077100 0.0000000-0.5573940
        WETTED PERIMETER/WETTED PERIMETER FULL = F(DEPTH/DEFINING DIMENSION)
        --------------------------------------------------------------------

             0.0705000 0.7300000-0.0058700 0.0058300
```

```
GUTTER CROSS-SECTION DATA

CODE   BOTTOM WIDTH (FT) INVERSE OF SIDE SLOPES   MANNING'S N
-----------------------------------------------------------------

     *** NO RATING CURVES SPECIFIED ***


    *** NO PUMP DATA SPECIFIED ***



NODE INPUT DATA

 NODE     LID      TYPE       COORDINATES           FLAG       OUTFALL      DIVERTED     MANHOLE    GROUNDWATER
 NO.   ELEVATION              N           E       ELEVATION    HGL EL       TO NODE       VOL          ELEV
----------------------------------------------------------------------------------------------------------------
 5001    407.00              0.00        0.00       0.00        0.00           0                       0.00
 5002    402.00              0.00        0.00       0.00        0.00           0                       0.00
 5003    401.00              0.00        0.00       0.00        0.00           0                       0.00
 5004    402.00              0.00        0.00       0.00        0.00           0                       0.00
 5005    401.00              0.00        0.00       0.00        0.00           0                       0.00
 5006    399.00              0.00        0.00       0.00        0.00           0                       0.00
 5007    398.00              0.00        0.00       0.00        0.00           0                       0.00
 5008    398.00              0.00        0.00       0.00        0.00           0                       0.00
 5009    398.00              0.00        0.00       0.00        0.00           0                       0.00
 5010    399.00              0.00        0.00       0.00        0.00           0                       0.00
 5011    398.00              0.00        0.00       0.00        0.00           0                       0.00
 5012    399.00              0.00        0.00       0.00        0.00           0                       0.00
 5013    399.00              0.00        0.00       0.00        0.00           0                       0.00
 5014    395.00              0.00        0.00       0.00        0.00           0                       0.00
 5015    393.00              0.00        0.00       0.00        0.00           0                       0.00
 5016    392.00              0.00        0.00       0.00        0.00           0                       0.00
 5017    391.00              0.00        0.00       0.00        0.00           0                       0.00
 5018    392.00              0.00        0.00       0.00        0.00           0                       0.00
 5019    388.00              0.00        0.00       0.00        0.00           0                       0.00
 5020    388.00              0.00        0.00       0.00        0.00           0                       0.00
 5021    386.00              0.00        0.00       0.00        0.00           0                       0.00
 5022    385.00              0.00        0.00       0.00        0.00           0                       0.00
 5023    385.00              0.00        0.00       0.00        0.00           0                       0.00
 5024    385.00              0.00        0.00       0.00      382.25           0                       0.00
```

```
L    SURF    DAT     ST     RUN    -- U    OF    E A    T/F    EA    CRE

NODE STORM        DATA FOR AREA 1                           DATA FOR ARFA 2                           DATA FOR ARFA 3                 FLOW SUBSF
 NO.  REF  CODE  AREA   SLOPE  LENGTH     N    CODE  AREA   SLOPE  LENGTH     N    CODE  AREA   SLOPE  LENGTH     N    RATIO RATIO
----- ----- ------------------------------------ - ------------------------------------ ------------------------------------ ----- -----
5001        M1   38.57 0.0050  1350.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5002        M1   26.58 0.0050   400.0  0.000    R1    8.61 0.0050   150.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5003        M1   21.97 0.0050   300.0  0.000    R1   26.50 0.0050   550.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5004        M1   18.78 0.0050   560.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5005        M1   39.34 0.0050  1200.0  0.000    R1    3.67 0.0050   300.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5006        M1   33.80 0.0050  1168.0  0.000    R1    7.40 0.0050   375.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5007        M1   10.38 0.0010   375.0  0.000    R1   11.29 0.0010   550.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5008        M1   69.30 0.0050   750.0  0.000    R1   50.73 0.0050  1000.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5009        M1    7.60 0.0050   800.0  0.000    R1   19.28 0.0050   600.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5010        M1   39.40 0.0030   500.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5011        R1   13.87 0.0050   645.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5012        R1   12.00 0.0010   400.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5013              0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5014        M1   20.78 0.0010   820.0  0.000    R1   19.90 0.0010   600.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5015        M1   30.24 0.0010  1250.0  0.000    R1   16.10 0.0010   380.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5016        M1    8.27 0.0010   300.0  0.000    R1   13.40 0.0010   350.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5017              0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5018        M1   14.70 0.0010   620.0  0.000    R1  100.00 0.0010   600.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5019        M1    7.10 0.0010   185.0  0.000    R1   22.40 0.0010   750.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5020              0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5021        M1  136.50 0.0030  1000.0  0.000    R1   37.80 0.0030   150.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5022              0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5023              0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000
5024              0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000          0.00 0.0000     0.0  0.000 0.000 0.000

TOTAL AREA CONTRIBUTING TO STORM RUNOFF -    886.260 ACRES

AREA AND CODF (WHICH RFFERS TO POPULATION DENSITIES) FOR  SANITARY FLOW DETERMINATION

NODE   CODE   AREA   CODE   AREA   CODE   AREA   POINT   REDUCED FLOW
 NO.    1      1      2      2      3      3     SOURCE      RATIO
----------------------------------------------------------------------
5001          0.00          0.00          0.00    0.00       0.000
5002          0.00          0.00          0.00    0.00       0.000
5003          0.00          0.00          0.00    0.00       0.000
5004          0.00          0.00          0.00    0.00       0.000
5005          0.00          0.00          0.00    0.00       0.000
5006          0.00          0.00          0.00    0.00       0.000
5007          0.00          0.00          0.00    0.00       0.000
5008          0.00          0.00          0.00    0.00       0.000
5009          0.00          0.00          0.00    0.00       0.000
5010          0.00          0.00          0.00    0.00       0.000
5011          0.00          0.00          0.00    0.00       0.000
5012          0.00          0.00          0.00    0.00       0.000
5013          0.00          0.00          0.00    0.00       0.000
5014          0.00          0.00          0.00    0.00       0.000
5015          0.00          0.00          0.00    0.00       0.000
5016          0.00          0.00          0.00    0.00       0.000
5017          0.00          0.00          0.00    0.00       0.000
5018          0.00          0.00          0.00    0.00       0.000
5019          0.00          0.00          0.00    0.00       0.000
5020          0.00          0.00          0.00    0.00       0.000
5021          0.00          0.00          0.00    0.00       0.000
5022          0.00          0.00          0.00    0.00       0.000
5023          0.00          0.00          0.00    0.00       0.000
5024          0.00          0.00          0.00    0.00       0.000

TOTAL AREA CONTRIBUTING TO SANITARY FLOWS -     0.000 ACRES

TOTAL CONTRIBUTING POPULATION EQUIVALENT  -     0.0
```

```
PIPE OR CONDUIT DATA

  PIPE  UPSTREAM  UPSTREAM   DOWNSTREAM  DOWNSTREAM   LENGTH   SIZE  MANNING'S  INFIL  SHAPF  SLOPF   Q FULL   CONTROL    AVAL.
  NO.     NODE    INVFRT EL     NODE      INVERT EL    (FT)    (IN)      N       CODE   CODE   FT/FT   (CFS)    GATFS     SECT.
                                                                                                              U/S  D/S   (FT.)
--------------------------------------------------------------------------------------------------------------------------------
    1     5001     397.85       5002       396.00     1230.0   42.0    0.013                 0.0015   39.02               0.0
    2     5002     396.00       5003       394.58     1420.0   48.0    0.013                 0.0010   45.42               0.0
    3     5003     394.58       5004       392.98     1000.0   48.0    0.013                 0.0016   57.46               0.0
    4     5004     392.58       5005       390.98     1000.0   48.0    0.013                 0.0016   57.46               0.0
    5     5005     390.98       5006       389.16      700.0   54.0    0.013                 0.0026  100.27               0.0
    6     5006     389.16       5007       388.25      350.0   54.0    0.013                 0.0026  100.27               0.0
    7     5008     391.00       5009       390.12      450.0   54.0    0.013                 0.0020   86.96               0.0
    8     5009     390.12       5010       388.75      700.0   54.0    0.013                 0.0020   87.00               0.0
    9     5010     388.75       5011       388.15      600.0   60.0    0.013                 0.0010   82.36               0.0
   10     5011     388.15       5012       387.45      700.0   60.0    0.013                 0.0010   82.36               0.0
   11     5012     387.45       5013       387.25      200.0   60.0    0.013                 0.0010   82.36               0.0
   12     5013     387.25       5007       386.50      750.0   60.0    0.013                 0.0010   82.36               0.0
   13     5007     386.50       5014       384.86     1250.0  108.0    0.033       ZZ     T3    0.0013  824.01               0.0
   14     5014     384.86       5015       383.16     1300.0  108.0    0.033       ZZ     T3    0.0013  822.66               0.0
   15     5015     383.16       5016       382.79      260.0  108.0    0.033       ZZ     T3    0.0013  826.97               0.0
   16     5016     382.79       5017       382.44      270.0  109.0    0.033       ZZ     T3    0.0013  819.07               0.0
   17     5017     382.44       5018       382.11      360.0   84.0    0.033       ZZ     T2    0.0009  583.62               0.0
   18     5018     382.11       5019       380.72     1575.0   84.0    0.033       ZZ     T2    0.0009  572.65               0.0
   19     5019     380.72       5020       380.63      105.0   78.0    0.013       ZZ           0.0009  153.49               0.0
   20     5020     380.63       5021       379.52     1260.0   84.0    0.033       ZZ     T2    0.0009  572.14               0.0
   21     5021     379.52       5022       378.29     1400.0   84.0    0.033       ZZ     T2    0.0009  571.37               0.0
   22     5022     378.29       5023       378.19      120.0   66.0    0.013       ZZ           0.0008   96.94               0.0
   23     5022     378.29       5023       378.19      120.0   66.0    0.013       ZZ           0.0008   96.94               0.0
   24     5023     378.19       5024       377.75      600.0   60.0    0.033       ZZ     T1    0.0007  258.71               0.0
                                                     --------
                              TOTAL LENGTH OF PIPES   17740.0
GUTTFR DATA

  NODE   ORDER    SHAPE    GUTTER   GUTTER     SHAPE    GUTTER   GUTTER     SHAPE    GUTTER   GUTTER
  NO.    CODE    CODE 1    SLOPE    LENGTH    CODE 2    SLOPE    LENGTH    CODE 3    SLOPE    LENGTH
 -----   -----   -------------------------   --------------------------   --------------------------
  5001     0              0.0000      0.              0.0000      0.              0.0000      0.
  5002     0              0.0000      0.              0.0000      0.              0.0000      0.
  5003     0              0.0000      0.              0.0000      0.              0.0000      0.
  5004     0              0.0000      0.              0.0000      0.              0.0000      0.
  5005     0              0.0000      0.              0.0000      0.              0.0000      0.
  5006     0              0.0000      0.              0.0000      0.              0.0000      0.
  5007     0              0.0000      0.              0.0000      0.              0.0000      0.
  5008     0              0.0000      0.              0.0000      0.              0.0000      0.
  5009     0              0.0000      0.              0.0000      0.              0.0000      0.
  5010     0              0.0000      0.              0.0000      0.              0.0000      0.
  5011     0              0.0000      0.              0.0000      0.              0.0000      0.
  5012     0              0.0000      0.              0.0000      0.              0.0000      0.
  5013     0              0.0000      0.              0.0000      0.              0.0000      0.
  5014     0              0.0000      0.              0.0000      0.              0.0000      0.
  5015     0              0.0000      0.              0.0000      0.              0.0000      0.
  5016     0              0.0000      0.              0.0000      0.              0.0000      0.
  5017     0              0.0000      0.              0.0000      0.              0.0000      0.
  5018     0              0.0000      0.              0.0000      0.              0.0000      0.
  5019     0              0.0000      0.              0.0000      0.              0.0000      0.
  5020     0              0.0000      0.              0.0000      0.              0.0000      0.
  5021     0              0.0000      0.              0.0000      0.              0.0000      0.
  5022     0              0.0000      0.              0.0000      0.              0.0000      0.
  5023     0              0.0000      0.              0.0000      0.              0.0000      0.
  5024     0              0.0000      0.              0.0000      0.              0.0000      0.
 POLL[illegible]T D[illegible]**

POLLUTANT  UNITS    DECAY    TEMPERATURE    ****************** W A S H O F F *******************    *** D R Y  W E A T H E R ***
  NAME      CODE  CONSTANT    CORRECTION     LAND  BUILD-UP  MAX DAYS OF  WASHOFF    SUBSURFACE      DENSITY
------------------------------------------    USE    RATE      BUILD-UP   CONSTANT  CONCENTRATION     CODE      CONCENTRATION
           *****    0.0157       0.0157     ----------------------------------------------------    ------------------------


UNITS                      BUILD-UP
 CODE   CONCENTRATIONS       RATE
-----------------------------------
 1           MG/L        LBS/AC/DAY
 2       ORG./100ML    1.0E6/AC/DAY
```

78

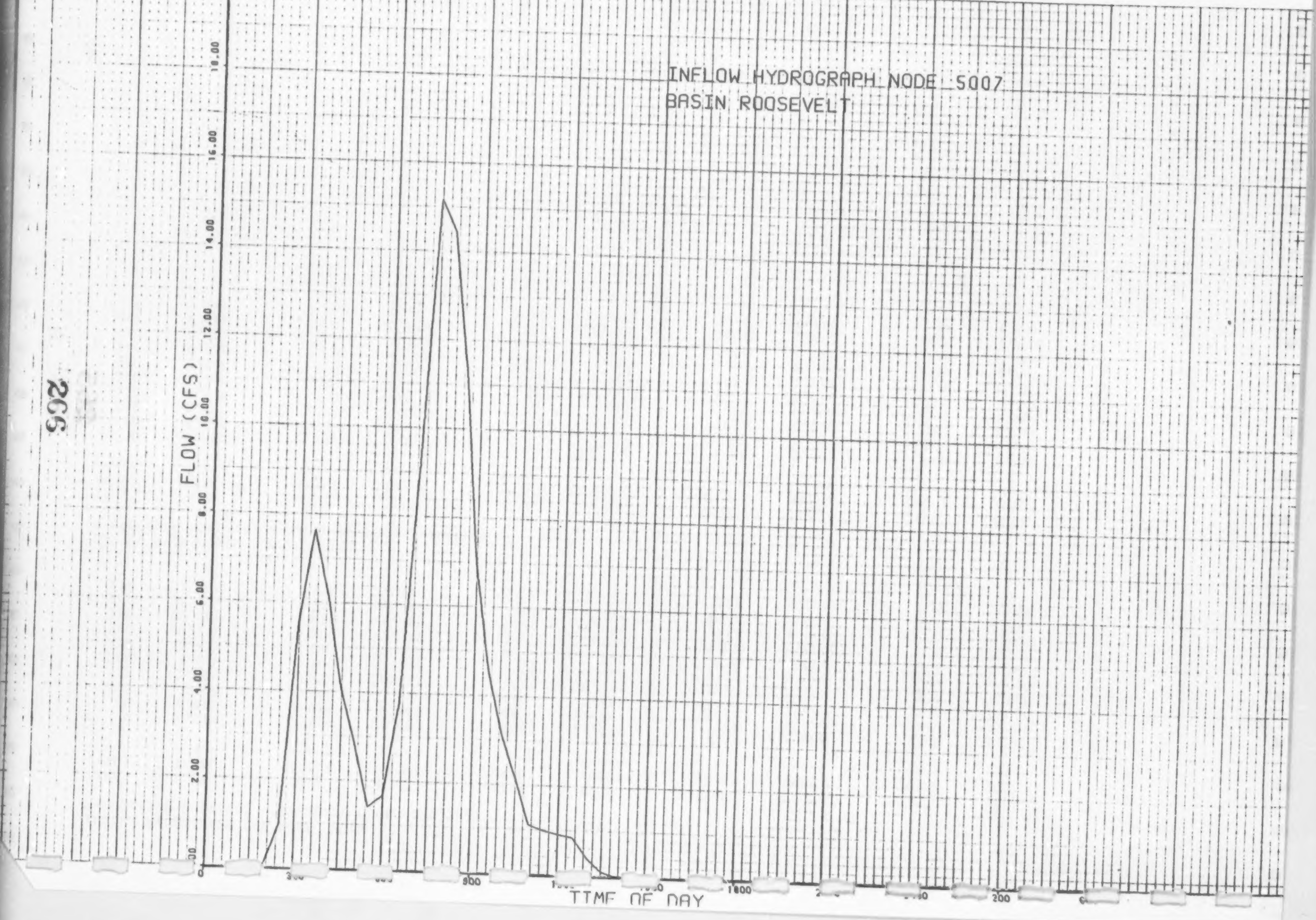
BM

```
INFLOW HYDROGRAPH FOR NODE  5002
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY

 TIME    FLOW       TIME    FLOW       TIME    FLOW       TIME    FLOW       TIME    FLOW
 (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)
 -----   -----      -----   -----      -----   -----      -----   -----      -----   -----

    0    0.000       500    2.950      1000    2.945      1500    0.000      2000    0.000
   30    0.000       530    0.727      1030    1.857      1530    0.000      2030    0.000
  100    0.001       600    2.311      1100    0.515      1600    0.000      2100    0.000
  130    0.003       630   10.962      1130    0.757      1630    0.000      2130    0.000
  200    0.208       700   27.340      1200    0.950      1700    0.000      2200    0.000
  230    5.219       730   29.735      1230    1.078      1730    0.000      2230    0.000
  300   23.103       800   21.380      1300    0.308      1800    0.000      2300    0.000
  330   15.235       830   15.157      1330    0.019      1830    0.000      2330    0.000
  400    7.969       900    6.613      1400    0.000      1900    0.000      2400    0.000
  430    4.537       930    4.484      1430    0.000      1930    0.000        30    0.000

INFLOW HYDROGRAPH FOR NODE  5007
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY

 TIME    FLOW       TIME    FLOW       TIME    FLOW       TIME    FLOW       TIME    FLOW
 (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)
 -----   -----      -----   -----      -----   -----      -----   -----      -----   -----

    0    0.000       500    2.862      1000    3.122      1500    0.000      2000    0.000
   30    0.000       530    1.419      1030    2.169      1530    0.000      2030    0.000
  100    0.000       600    1.684      1100    1.116      1600    0.000      2100    0.000
  130    0.001       630    3.780      1130    1.001      1630    0.000      2130    0.000
  200    0.040       700    9.193      1200    0.919      1700    0.000      2200    0.000
  230    0.996       730   15.150      1230    0.858      1730    0.000      2230    0.000
  300    5.531       800   14.432      1300    0.413      1800    0.000      2300    0.000
  330    7.638       830   11.360      1330    0.108      1830    0.000      2330    0.000
  400    6.107       900    6.967      1400    0.008      1900    0.000      2400    0.000
  430    4.094       930    4.569      1430    0.000      1930    0.000        30    0.000

INFLOW HYDROGRAPH FOR NODE  5008
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY

 TIME    FLOW       TIME    FLOW       TIME    FLOW       TIME    FLOW       TIME    FLOW
 (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)      (MIL)   (CFS)
 -----   -----      -----   -----      -----   -----      -----   -----      -----   -----

    0    0.000       500   15.204      1000   15.683      1500    0.000      2000    0.000
   30    0.000       530    6.968      1030   10.708      1530    0.000      2030    0.000
  100    0.001       600    9.059      1100    5.115      1600    0.000      2100    0.000
  130    0.005       630   22.520      1130    4.798      1630    0.000      2130    0.000
  200    0.290       700   56.595      1200    4.568      1700    0.000      2200    0.000
  230    7.129       730   90.849      1230    4.396      1730    0.000      2230    0.000
  300   37.226       800   81.296      1300    1.969      1800    0.000      2300    0.000
  330   47.438       830   61.834      1330    0.494      1830    0.000      2330    0.000
  400   35.198       900   36.034      1400    0.016      1900    0.000      2400    0.000
  430   22.365       930   23.202      1430    0.000      1930    0.000        30    0.000
```

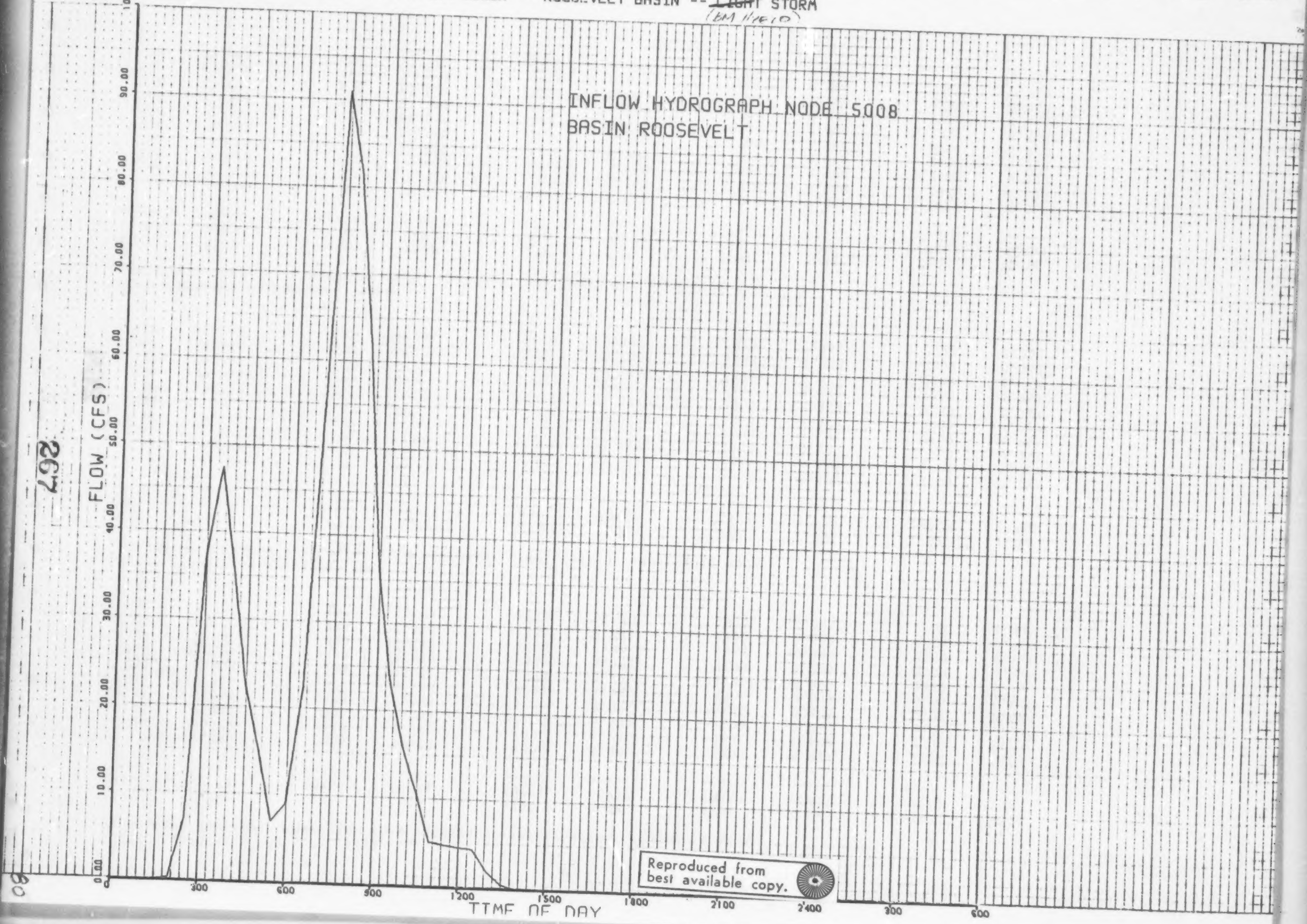
BM

```
INFLOW HYDROGRAPH FOR NODE  5018
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY

 TIME       FLOW          TIME      FLOW          TIME      FLOW          TIME      FLOW          TIME      FLOW
 (MIL)      (CFS)         (MIL)     (CFS)         (MIL)     (CFS)         (MIL)     (CFS)         (MIL)     (CFS)
 -----      -----         -----     -----         -----     -----         -----     -----         -----     -----

     0      0.000           500    15.699          1000    19.046          1500     0.000          2000     0.000
    30      0.000           530     8.607          1030    13.587          1530     0.000          2030     0.000
   100      0.000           600     8.699          1100     7.493          1600     0.000          2100     0.000
   130      0.001           630    16.282          1130     6.334          1630     0.000          2130     0.000
   200      0.035           700    37.348          1200     5.497          1700     0.000          2200     0.000
   230      1.445           730    65.927          1230     4.875          1730     0.000          2230     0.000
   300     15.376           800    72.267          1300     2.427          1800     0.000          2300     0.000
   330     28.585           830    61.355          1330     0.606          1830     0.000          2330     0.000
   400     28.271           900    40.984          1400     0.115          1900     0.000          2400     0.000
   430     21.378           930    27.602          1430     0.015          1930     0.000            30     0.000

INFLOW HYDROGRAPH FOR NODE  5022
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY

 TIME       FLOW          TIME      FLOW          TIME      FLOW          TIME      FLOW          TIME      FLOW
 (MIL)      (CFS)         (MIL)     (CFS)         (MIL)     (CFS)         (MIL)     (CFS)         (MIL)     (CFS)
 -----      -----         -----     -----         -----     -----         -----     -----         -----     -----

     0      0.000           500     0.000          1000     0.000          1500     0.000          2000     0.000
    30      0.000           530     0.000          1030     0.000          1530     0.000          2030     0.000
   100      0.000           600     0.000          1100     0.000          1600     0.000          2100     0.000
   130      0.000           630     0.000          1130     0.000          1630     0.000          2130     0.000
   200      0.000           700     0.000          1200     0.000          1700     0.000          2200     0.000
   230      0.000           730     0.000          1230     0.000          1730     0.000          2230     0.000
   300      0.000           800     0.000          1300     0.000          1800     0.000          2300     0.000
   330      0.000           830     0.000          1330     0.000          1830     0.000          2330     0.000
   400      0.000           900     0.000          1400     0.000          1900     0.000          2400     0.000
   430      0.000           930     0.000          1430     0.000          1930     0.000            30     0.000
```

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM



TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM
(BM 11/4/10)



Reproduced from
best available copy.

BM

```
ROUTED HYDROGRAPH FOR NODE  5002
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY  INFILTRATION  KINEMATIC WAVE

TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW
(MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)
-----    -----       -----    -----       -----    -----       -----    -----       -----    -----

    0    0.040         500    9.678        1000    9.896        1500    0.073        2000    0.040
   30    0.040         530    4.799        1030    6.830        1530    0.040        2030    0.040
  100    0.041         600    6.354        1100    3.637        1600    0.040        2100    0.040
  130    0.044         630   17.875        1130    3.326        1630    0.040        2130    0.040
  200    0.310         700   42.569        1200    3.182        1700    0.040        2200    0.040
  230    6.858         730   55.464        1230    3.175        1730    0.040        2230    0.040
  300   31.759         800   48.420        1300    1.771        1800    0.040        2300    0.040
  330   29.087         830   37.570        1330    0.956        1830    0.040        2330    0.040
  400   20.780         900   21.423        1400    0.471        1900    0.040        2400    0.040
  430   13.858         930   14.463        1430    0.188        1930    0.040          30    0.040

ROUTED HYDROGRAPH FOR NODE  5007
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY  INFILTRATION  KINEMATIC WAVE

TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW
(MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)
-----    -----       -----    -----       -----    -----       -----    -----       -----    -----

    0    0.363         500   64.598        1000   66.103        1500    0.685        2000    0.363
   30    0.363         530   34.122        1030   44.337        1530    0.530        2030    0.364
  100    0.367         600   34.917        1100   25.443        1600    0.389        2100    0.363
  130    0.376         630   81.414        1130   19.586        1630    0.387        2130    0.363
  200    1.063         700  197.531        1200   17.898        1700    0.357        2200    0.363
  230   22.773         730  345.979        1230   17.374        1730    0.368        2230    0.363
  300  135.658         800  309.026        1300   11.053        1800    0.360        2300    0.363
  330  177.827         830  240.231        1330    6.153        1830    0.365        2330    0.363
  400  144.436         900  160.267        1400    2.769        1900    0.362        2400    0.363
  430   95.208         930   98.967        1430    1.369        1930    0.364          30    0.363

ROUTED HYDROGRAPH FOR NODE  5008
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY  INFILTRATION  KINEMATIC WAVE

TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW        TIME     FLOW
(MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)       (MIL)    (CFS)
-----    -----       -----    -----       -----    -----       -----    -----       -----    -----

    0    0.000         500   15.204        1000   15.683        1500    0.000        2000    0.000
   30    0.000         530    6.968        1030   10.708        1530    0.000        2030    0.000
  100    0.001         600    9.059        1100    5.115        1600    0.000        2100    0.000
  130    0.005         630   22.520        1130    4.798        1630    0.000        2130    0.000
  200    0.290         700   56.595        1200    4.568        1700    0.000        2200    0.000
  230    7.129         730   90.849        1230    4.396        1730    0.000        2230    0.000
  300   37.226         800   81.296        1300    1.969        1800    0.000        2300    0.000
  330   47.438         830   61.834        1330    0.494        1830    0.000        2330    0.000
  400   35.198         900   36.034        1400    0.016        1900    0.000        2400    0.000
  430   22.365         930   23.202        1430    0.000        1930    0.000          30    0.000
```

BM

```
ROUTED HYDROGRAPH FOR NODE  5018
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY  INFILTRATION  KINEMATIC WAVE
 TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW
 (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)
 -----     -----       -----     -----       -----     -----       -----     -----       -----     -----

     0     0.363        500   118.408        1000   129.190        1500     1.688        2000     0.361
    30     0.363        530    72.144        1030    88.902        1530     0.944        2030     0.365
   100     0.366        600    59.372        1100    54.942        1600     0.493        2100     0.362
   130     0.373        630    95.179        1130    39.990        1630     0.449        2130     0.364
   200     0.844        700   221.340        1200    31.832        1700     0.358        2200     0.363
   230    16.521        730   405.180        1230    28.942        1730     0.383        2230     0.364
   300   119.200        800   439.146        1300    20.380        1800     0.353        2300     0.363
   330   197.139        830   387.413        1330    12.821        1830     0.371        2330     0.364
   400   206.840        900   280.499        1400     6.878        1900     0.358        2400     0.363
   430   162.957        930   192.920        1430     3.743        1930     0.367          30     0.363

ROUTED HYDROGRAPH FOR NODE  5022
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY  INFILTRATION  KINEMATIC WAVE
 TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW        TIME      FLOW
 (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)       (MIL)     (CFS)
 -----     -----       -----     -----       -----     -----       -----     -----       -----     -----

     0     0.363        500   178.571        1000   205.908        1500     7.094        2000     0.361
    30     0.363        530   122.752        1030   146.394        1530     4.307        2030     0.365
   100     0.365        600    97.255        1100    97.996        1600     2.406        2100     0.362
   130     0.369        630   116.198        1130    71.494        1630     1.415        2130     0.364
   200     0.676        700   250.093        1200    53.212        1700     0.794        2200     0.363
   230    11.640        730   443.293        1230    44.719        1730     0.556        2230     0.364
   300   109.963        800   524.057        1300    34.327        1800     0.416        2300     0.363
   330   190.273        830   509.833        1330    26.388        1830     0.391        2330     0.364
   400   244.568        900   400.347        1400    17.762        1900     0.364        2400     0.363
   430   218.463        930   294.410        1430    11.787        1930     0.369          30     0.363
```

```
HYDRAULIC GRADE LINE ELEVATION VS TIME FOR NODE  5007
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY  INFILTRATION  KINEMATIC WAVE
INVERT ELEVATION OF DOWNSTREAM PIPE =  386.50  SIZE = 8.98 FEET   Q FULL = 824.01 (CFS)
MAXIMUM DEPTH =  6.96  MAXIMUM HGL =  393.46  MAXIMUM FLOW RATE = 345.98  FLAG ELEVATION =   398.01
  TIME     DEPTH     HGL ELEV     TOTAL      VELOCITY
 (MIL)      (FT)       (FT)        FLOW        (FPS)
 -----     -----     --------     (CFS)      --------
     0      0.68      387.18      0.363         0.1
    30      0.68      387.18      0.363         0.1
   100      0.68      387.18      0.367         0.1
   130      0.68      387.18      0.376         0.1
   200      0.70      387.20      1.063         0.1
   230      1.20      387.70     22.773         0.1
   300      3.65      390.15    135.658         0.7
   330      4.46      390.96    177.827         1.7
   400      3.83      390.33    144.436         1.8
   430      2.81      389.31     95.208         1.7
   500      2.15      388.65     64.598         1.4
   530      1.46      387.96     34.122         1.2
   600      1.48      387.98     34.917         0.9
   630      2.52      389.02     81.414         0.9
   700      4.82      391.32    197.531         1.4
   730      6.96      393.46    345.979         1.9
   800      6.52      393.02    309.026         2.4
   830      5.53      392.03    240.231         2.2
   900      4.14      390.64    160.267         2.0
   930      2.89      389.39     98.967         1.8
  1000      2.18      388.68     66.103         1.5
  1030      1.69      388.19     44.337         1.2
  1100      1.26      387.76     25.443         1.0
  1130      1.13      387.63     19.586         0.7
  1200      1.09      387.59     17.898         0.6
  1230      1.08      387.58     17.374         0.6
  1300      0.93      387.43     11.053         0.6
  1330      0.82      387.32      6.153         0.4
  1400      0.74      387.24      2.769         0.3
  1430      0.71      387.21      1.369         0.1
  1500      0.69      387.19      0.685         0.1
  1530      0.69      387.19      0.530         0.1
  1600      0.68      387.18      0.389         0.1
  1630      0.68      387.18      0.387         0.1
  1700      0.68      387.18      0.357         0.1
  1730      0.68      387.18      0.368         0.1
  1800      0.68      387.18      0.360         0.1
  1830      0.68      387.18      0.365         0.1
  1900      0.68      387.18      0.362         0.1
  1930      0.68      387.18      0.364         0.1
  2000      0.68      387.18      0.363         0.1
  2030      0.68      387.18      0.364         0.1
  2100      0.68      387.18      0.363         0.1
  2130      0.68      387.18      0.363         0.1
  2200      0.68      387.18      0.363         0.1
  2230      0.68      387.18      0.363         0.1
  2300      0.68      387.18      0.363         0.1
  2330      0.68      387.18      0.363         0.1
  2400      0.68      387.18      0.363         0.1
    30      0.68      387.18      0.363         0.1
```

```
HYDRAULIC GRADE LINE ELEVATION VS TIME FOR NODE  5008
HYDROGRAPH CONTAINS - OVERLAND FLOW  SANITARY  INFILTRATION  KINEMATIC WAVE
INVERT ELEVATION OF DOWNSTREAM PIPE =   391.00  SIZE = 4.51 FEET   Q FULL =  86.96 (CFS)
MAXIMUM DEPTH = 13.38  MAXIMUM HGL =   404.38  MAXIMUM FLOW RATE =   90.85  FLAG ELEVATION =    398.01

 TIME     DEPTH     HGL ELEV     TOTAL      VELOCITY
 (MIL)     (FT)       (FT)        FLOW       (FPS)
 -----    -----    ---------     (CFS)     --------
     0     0.00      391.00     0.000         0.0
    30     0.00      391.00     0.000         0.0
   100     0.00      391.00     0.001         0.0
   130     0.00      391.00     0.005         0.0
   200     0.06      391.06     0.290         2.9
   230     0.86      391.86     7.129         3.2
   300     2.08      393.08    37.226         5.1
   330     2.34      393.34    47.438         5.6
   400     2.03      393.03    35.198         5.0
   430     1.64      392.64    22.365         4.2
   500     1.34      392.34    15.204         3.8
   530     0.85      391.85     6.968         3.2
   600     1.00      392.00     9.059         3.3
   630     1.64      392.64    22.520         4.2
   700     4.39      395.39    56.595         3.6
   730    13.38      404.38    90.849         5.8
   800    10.94      401.94    81.296         5.2
   830     6.14      397.14    61.834         3.9
   900     2.05      393.05    36.034         5.1
   930     1.67      392.67    23.202         4.3
  1000     1.37      392.37    15.683         3.8
  1030     1.11      392.11    10.708         3.4
  1100     0.69      391.69     5.115         3.1
  1130     0.66      391.66     4.798         3.0
  1200     0.64      391.64     4.568         3.0
  1230     0.62      391.62     4.396         3.0
  1300     0.34      391.34     1.969         2.9
  1330     0.10      391.10     0.494         2.8
  1400     0.00      391.00     0.016         0.0
  1430     0.00      391.00     0.000         0.0
  1500     0.00      391.00     0.000         0.0
  1530     0.00      391.00     0.000         0.0
  1600     0.00      391.00     0.000         0.0
  1630     0.00      391.00     0.000         0.0
  1700     0.00      391.00     0.000         0.0
  1730     0.00      391.00     0.000         0.0
  1800     0.00      391.00     0.000         0.0
  1830     0.00      391.00     0.000         0.0
  1900     0.00      391.00     0.000         0.0
  1930     0.00      391.00     0.000         0.0
  2000     0.00      391.00     0.000         0.0
  2030     0.00      391.00     0.000         0.0
  2100     0.00      391.00     0.000         0.0
  2130     0.00      391.00     0.000         0.0
  2200     0.00      391.00     0.000         0.0
  2230     0.00      391.00     0.000         0.0
  2300     0.00      391.00     0.000         0.0
  2330     0.00      391.00     0.000         0.0
  2400     0.00      391.00     0.000         0.0
    30     0.00      391.00     0.000         0.0
```

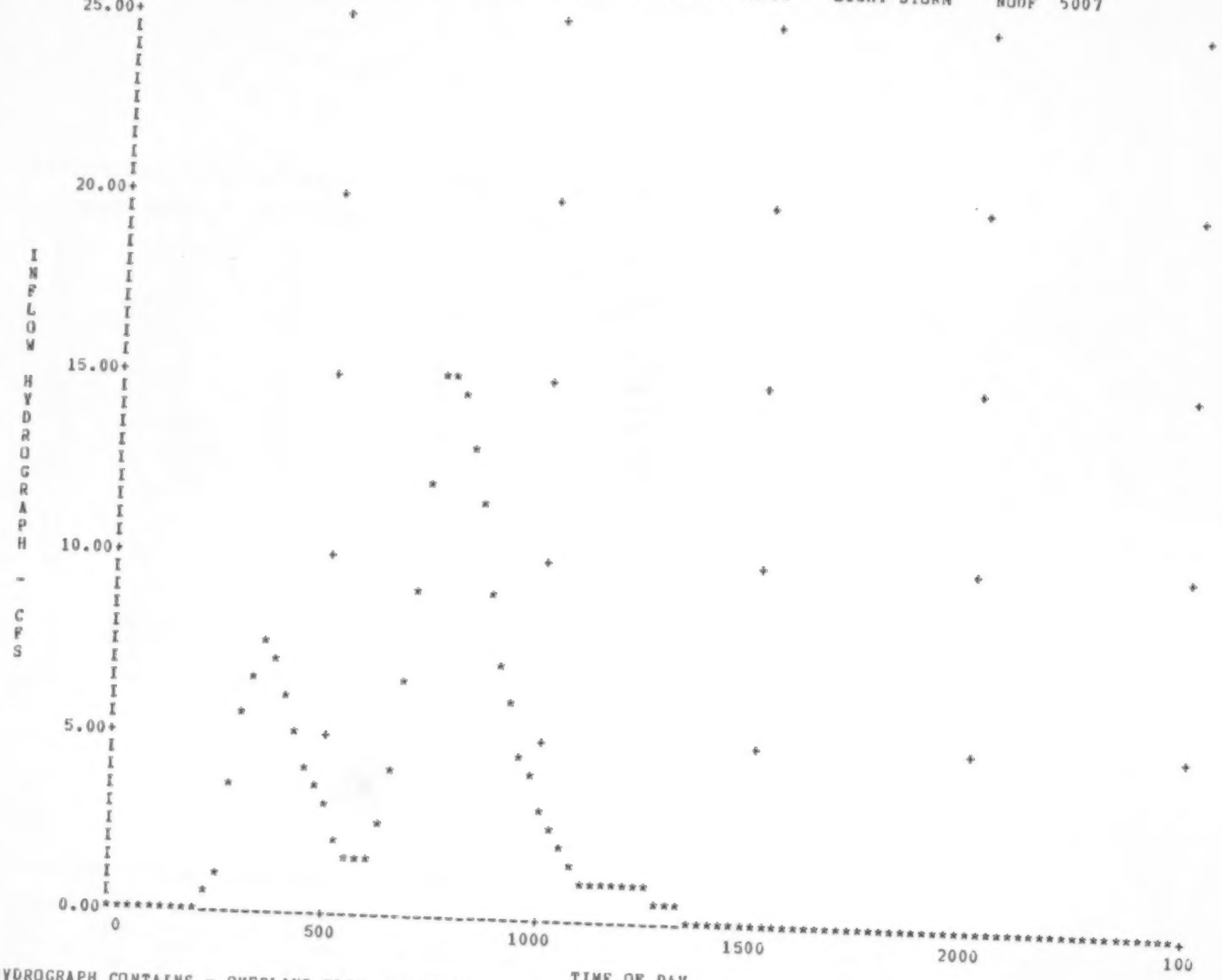
```
LIST OF NODES AT WHICH THE HGL EXCEEDS THE FLAG ELEVATION OR MANHOLE LID ELEVATION

 NODE    CRITICAL   EXCEEDED   MANHOLE LID   EXCEEDED   MAXIMUM HGL   MILITARY
  NO.   ELEVATION    (TIME)     ELEVATION     (TIME)     ELEVATION      TIME
 -----  --------------------   ----------------------   ----------------------
 5002       0.00        0         402.00        730        411.59        730
 5008       0.00        0         398.00        730        404.38        730
 5022       0.00        0         385.00        800        385.22        800
```

TIME OF DAY
OF FIRST
OCCURRENCE

```
MAXIMUM HYDRAULIC GRADE LINE

 NODE     TIME     DEPTH    PIPE DEPTH    HGL ELEV
          (MIL)     (FT)       (FT)         (FT)
 ----     ----     -----    ----------    --------
 5002      730     15.59       4.01        411.59
 5007      730      6.96       8.98        393.46
 5008      730     13.38       4.51        404.38
 5018      800      6.59       7.00        388.70
 5022      800      6.93       5.51        385.22


TOTAL VOLUMES OF FLOW
             INFLOW HYDROGRAPH                 ROUTED HYDROGRAPH
NODE      CUBIC FEET        ACRE FEET       CUBIC FEET       ACRE FEET
5002       335453.24          7.7009         712255.20         16.3511
5007       189967.92          4.3611        4257667.30         97.7426
5008      1081730.50         24.8331        1081730.50         24.8331
5018       917737.46         21.0684        6126445.60        140.6438
5022            0.00          0.0000        8002079.60        183.7025


SURCHARGED MANHOLES

 NODE   TIME OF INITIAL          HGL   TIME OF MAXIMUM          HGL   TOTAL TIME SURCHARGED
        SURCHARGE (MIL)         ELEV   SURCHARGE (MIL)         ELEV       (HR AND MIN)
 -----  ------------------------------  ------------------------------  ---------------------
 5002         700             401.85         730             411.59            200
 5008         730             404.38         730             404.38            130
 5022         400             383.80         800             385.22            330
```

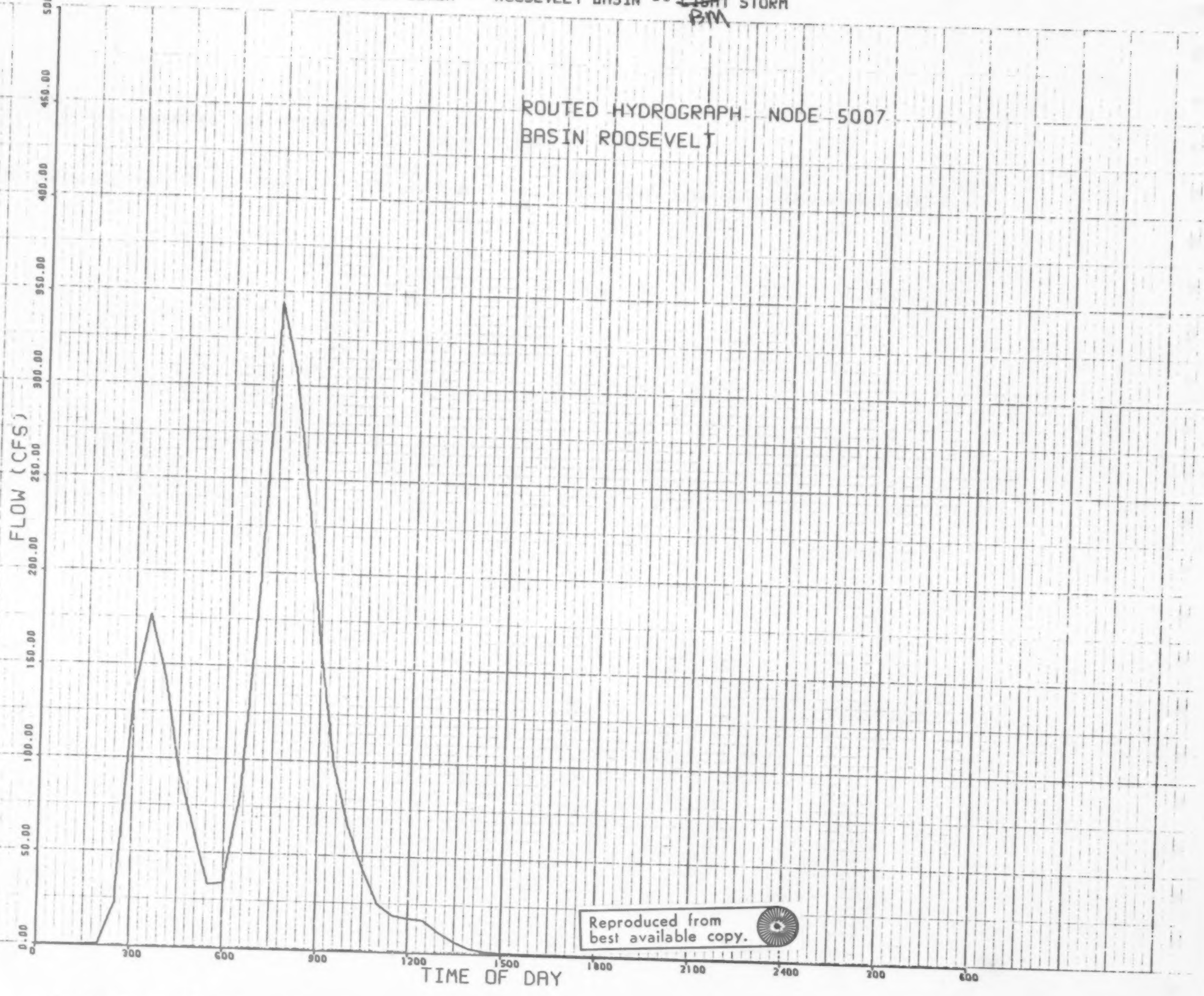
```
PEAK FLOWS AND HYDRAULIC GRADE LINES

                                          PEAK Q                                        SURCH.  REQ. DIA.  REQ. DIA.  OVFLW PIPE
      DISCH.  SIZE  SHAPE         CAPACITY AT NODE  TIME   MAX     MAX       LID    DURING  AT PIPE    AT GROUND  REQ. DIA.
 NODE  PIPE   (IN)   CODE  SLOPE   (CFS)    (CFS)  (MIL)  DEPTH    HGL      ELEV    (HHMM)  SLOPE(IN)  SLOPE(IN)  AT PIPE      PCT.
                                                                                                                   SLOPE(IN)    CAP.
-----------------------------------------------------------------------------------------------------------------------------------
 5002    2    48.0        0.0010   45.424   55.464   730   15.6   411.59    402.00    200      51.7       55.3       27.3      122.10
 5007   13   108.0    T3  0.0013  824.012  345.979   730    7.0   393.46    398.00      0      97.7       87.2        0.0       41.99
 5008    7    54.0        0.0020   86.962   90.849   730   13.4   404.38    398.00    130      54.9        0.0       16.8      104.47
 5018   18    84.0    T2  0.0009  572.655  439.146   800    6.6   388.70    392.00      0     115.1       94.4        0.0       75.69
 5022   ( TWO DOWNSTREAM PIPES )           524.057   800          385.22    385.00
*PRINT INFILTRATION  00002 00007 00013 00018 00022




            *****  PIPE INFILTRATION  *****
 PIPE    LENGTH     CONDITION     SHAPE CODE     INFILTRATION
   1    1230.00                                      0.0400
   2    1420.00                                      0.0527
   3    1000.00                                      0.0371
   4    1000.00                                      0.0371
   5     700.00                                      0.0292
   6     350.00                                      0.0146
   7     450.00                                      0.0188
   8     700.00                                      0.0292
   9     600.00                                      0.0278
  10     700.00                                      0.0325
  11     200.00                                      0.0093
  12     750.00                                      0.0348
  13    1250.00        ZZ            T3              0.0000
  14    1300.00        ZZ            T3              0.0000
  15     290.00        ZZ            T3              0.0000
  16     270.00        ZZ            T3              0.0000
  17     360.00        ZZ            T2              0.0000
  18    1575.00        ZZ            T2              0.0000
  19     105.00        ZZ                            0.0000
  20    1260.00        ZZ            T2              0.0000
  21    1400.00        ZZ            T2              0.0000
  22     120.00        ZZ                            0.0000
  23     120.00        ZZ                            0.0000
  24     600.00        ZZ            T1              0.0000
    TOTAL VOLUME OF PIPE INFILTRATION -     32691.90 CU FT     0.7505 AC FT
*PRINTER PLOT STORM HYDROGRAPHS 05002 05007 05008 05018 05022
```

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM   NODE 5007



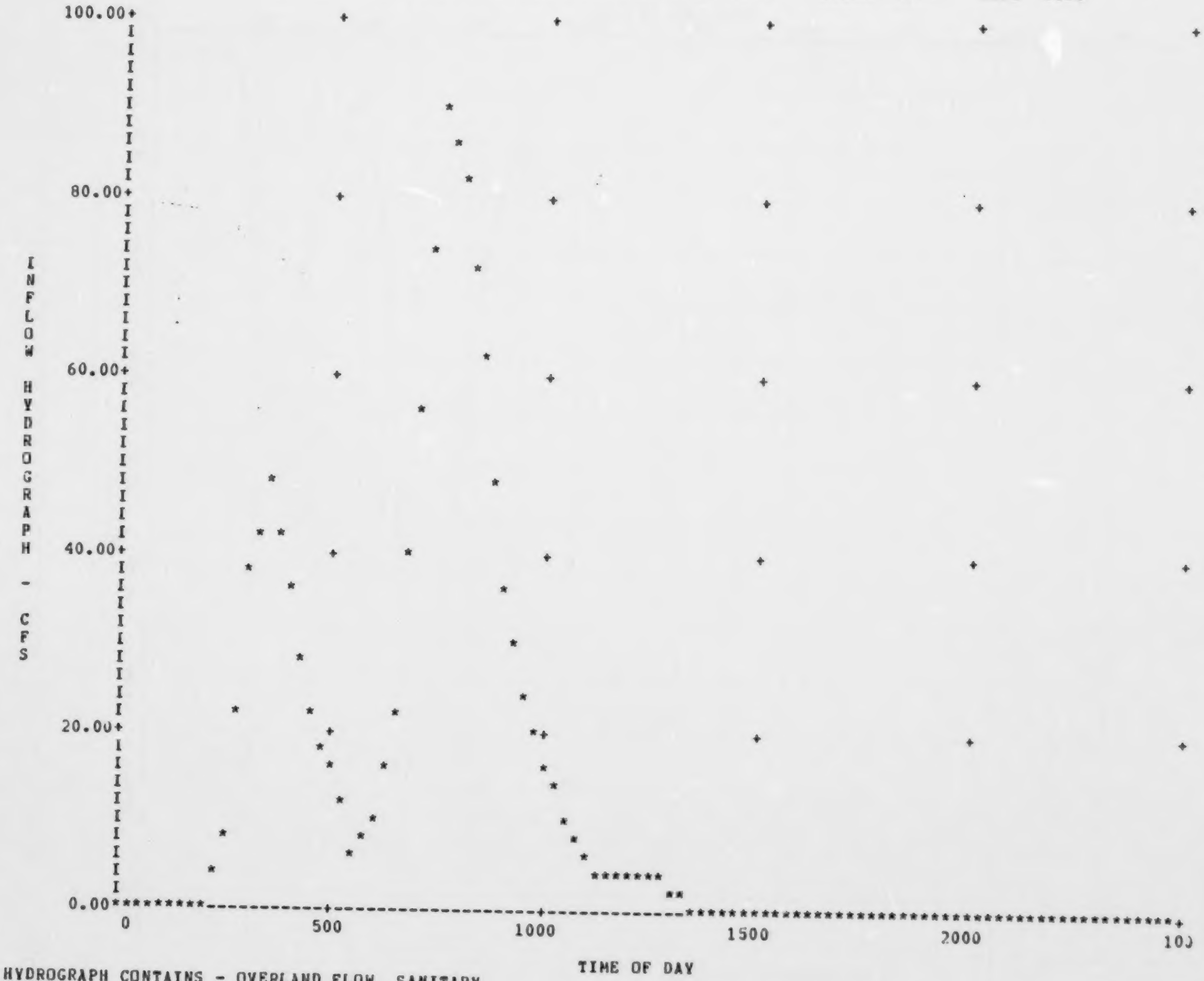
HYDROGRAPH CONTAINS - OVERLAND FLOW SANITARY
BASIN ROOSEVELT

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM



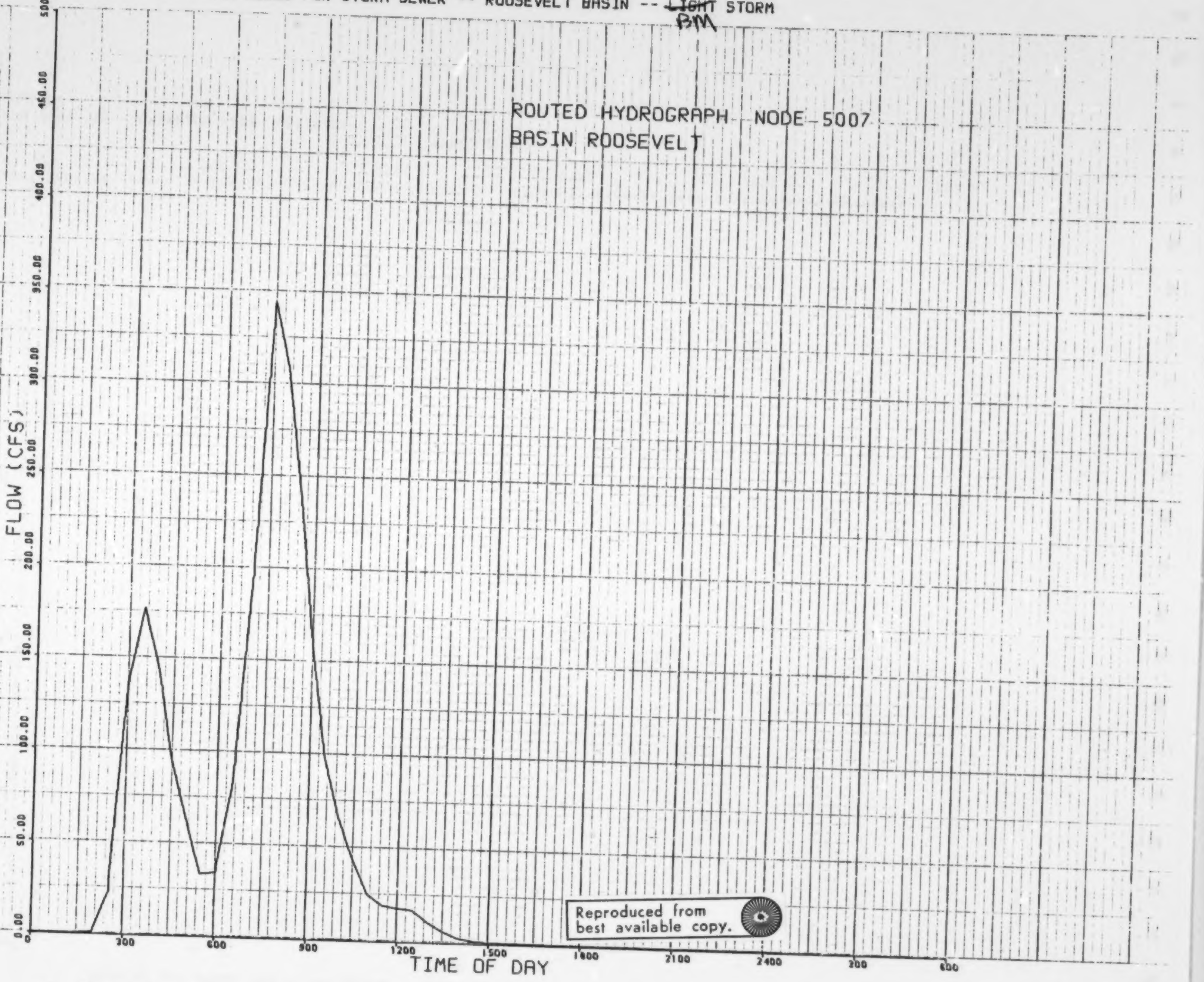
Reproduced from best available copy.

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM NODE 5008

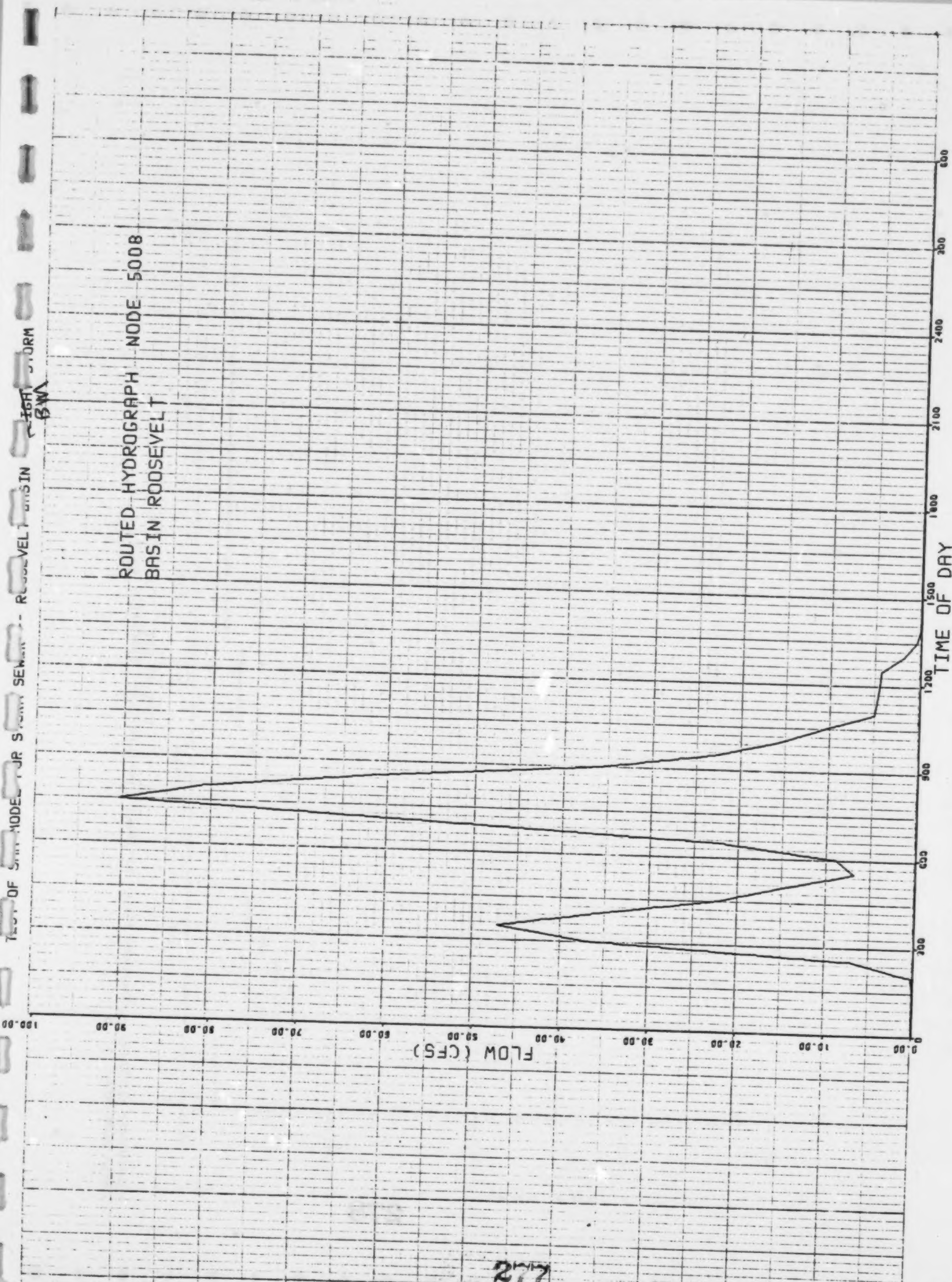


HYDROGRAPH CONTAINS - OVERLAND FLOW SANITARY
BASIN ROOSEVELT

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM

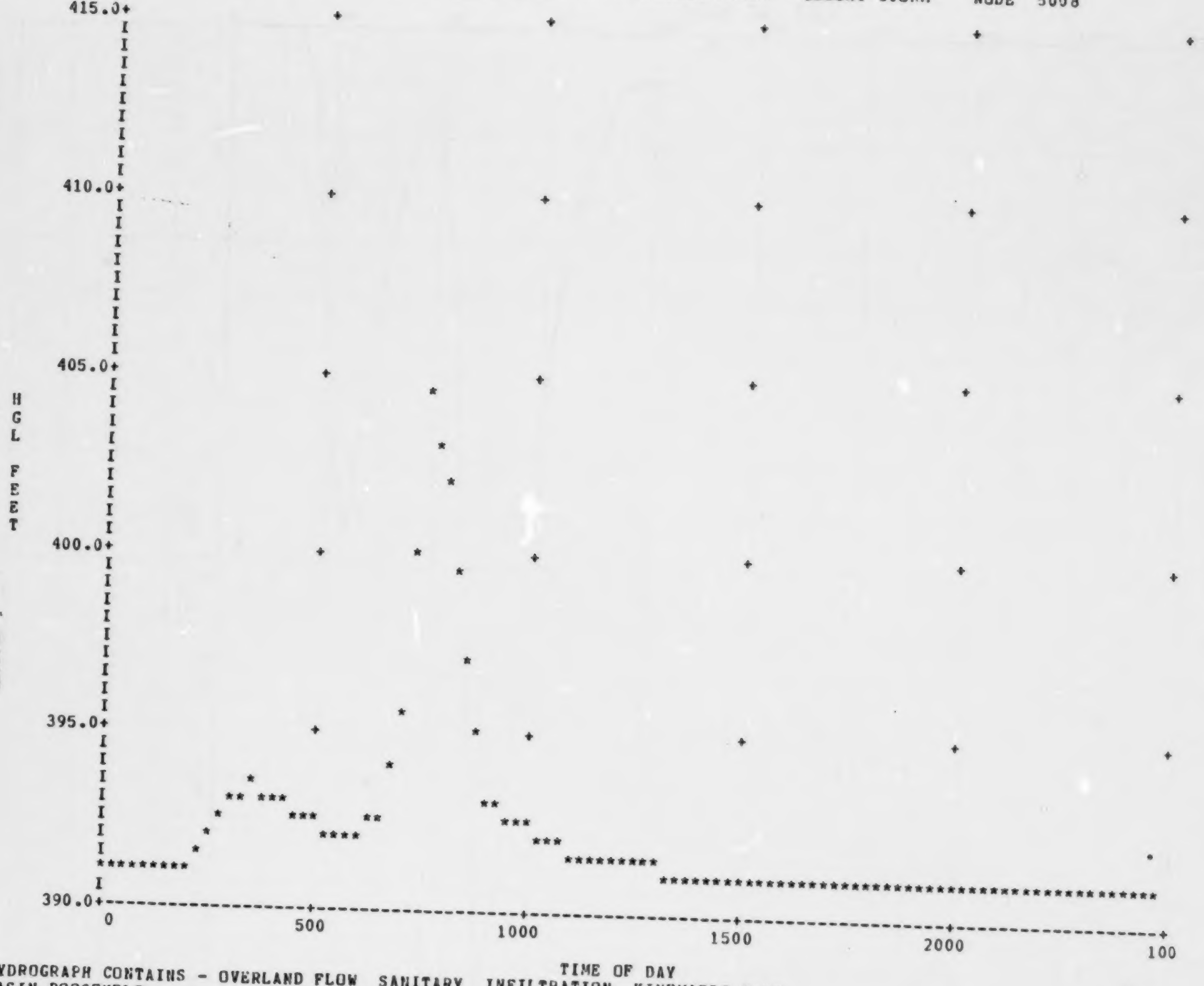


Reproduced from best available copy.


OF
MODEL
SEWER -
ROOSEVELT BASIN
STORM
BWA
ROUTED HYDROGRAPH NODE 5008
BASIN ROOSEVELT
FLOW (CFS)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
TIME OF DAY
300
600
900
1200
1500
1800
2100
2400
300
600

277

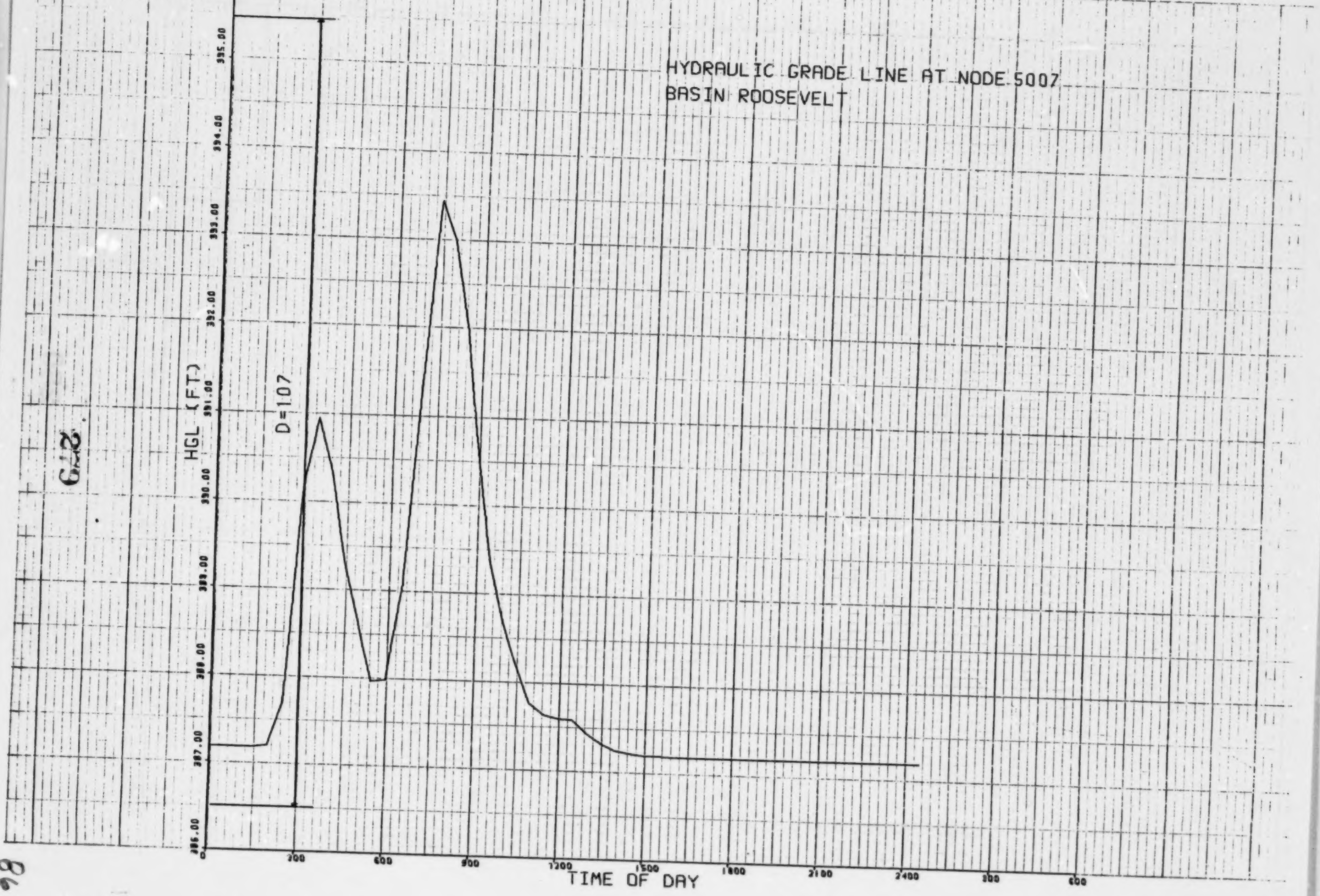
TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BM STORM   NODE 5008



HYDROGRAPH CONTAINS - OVERLAND FLOW SANITARY INFILTRATION KINEMATIC WAVE
BASIN ROOSEVELT

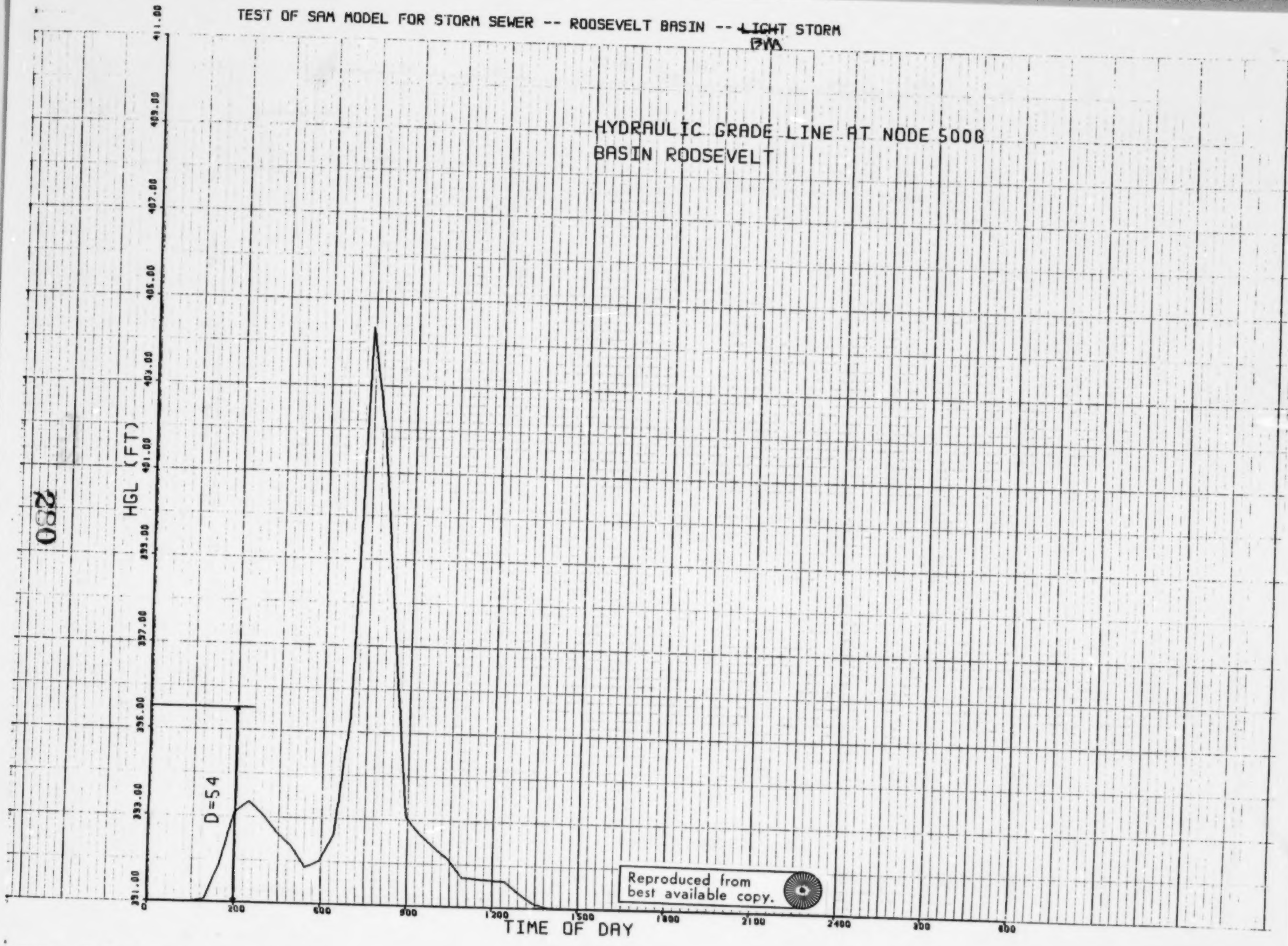
TEST OF SAN MODEL FOR STORM SEWER - ROOSEVELT BASIN - LIGHT STORM

BW



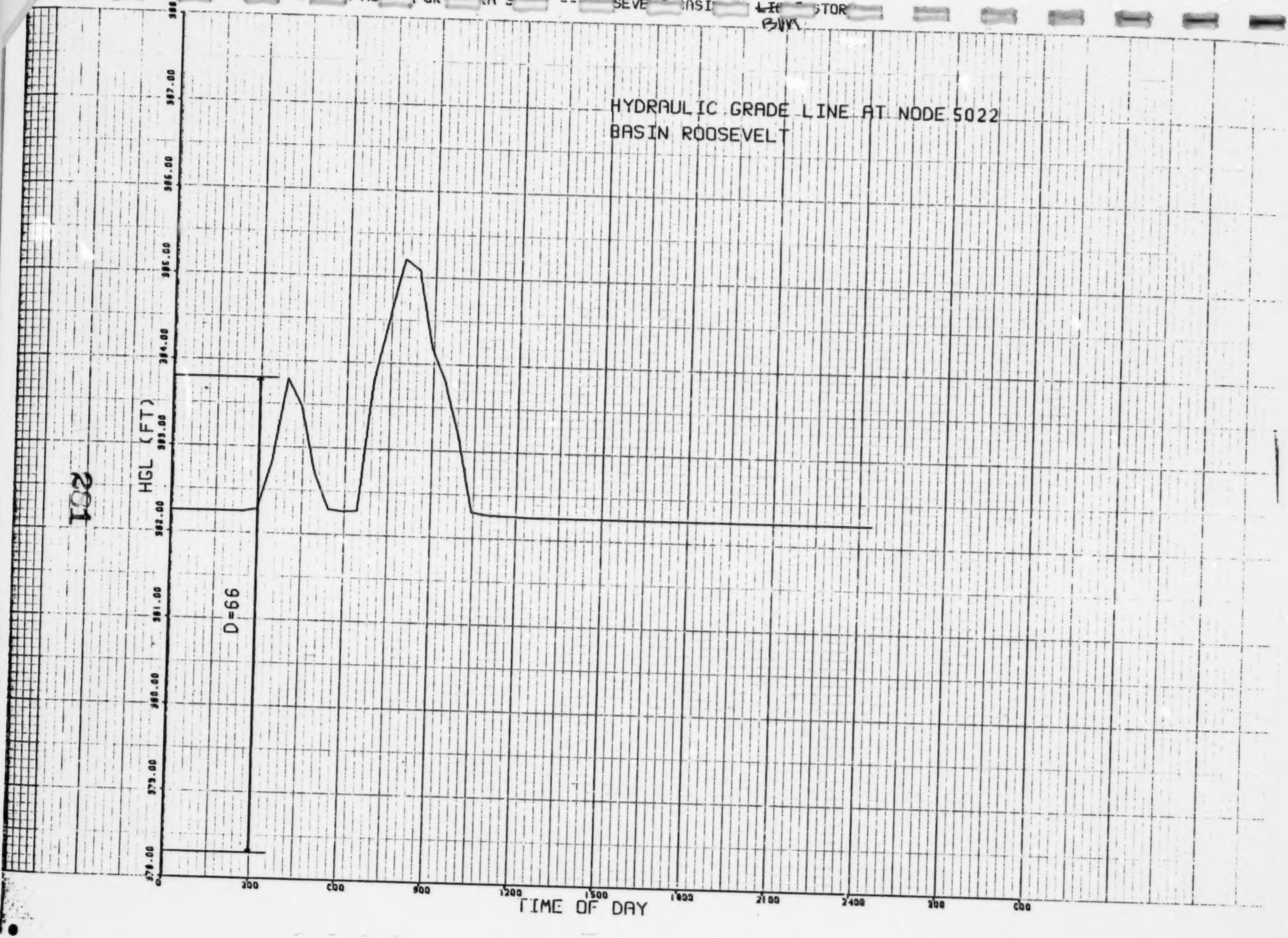
86

TEST OF SAM MODEL FOR STORM SEWER -- ROOSEVELT BASIN -- ~~LIGHT~~ BWA STORM



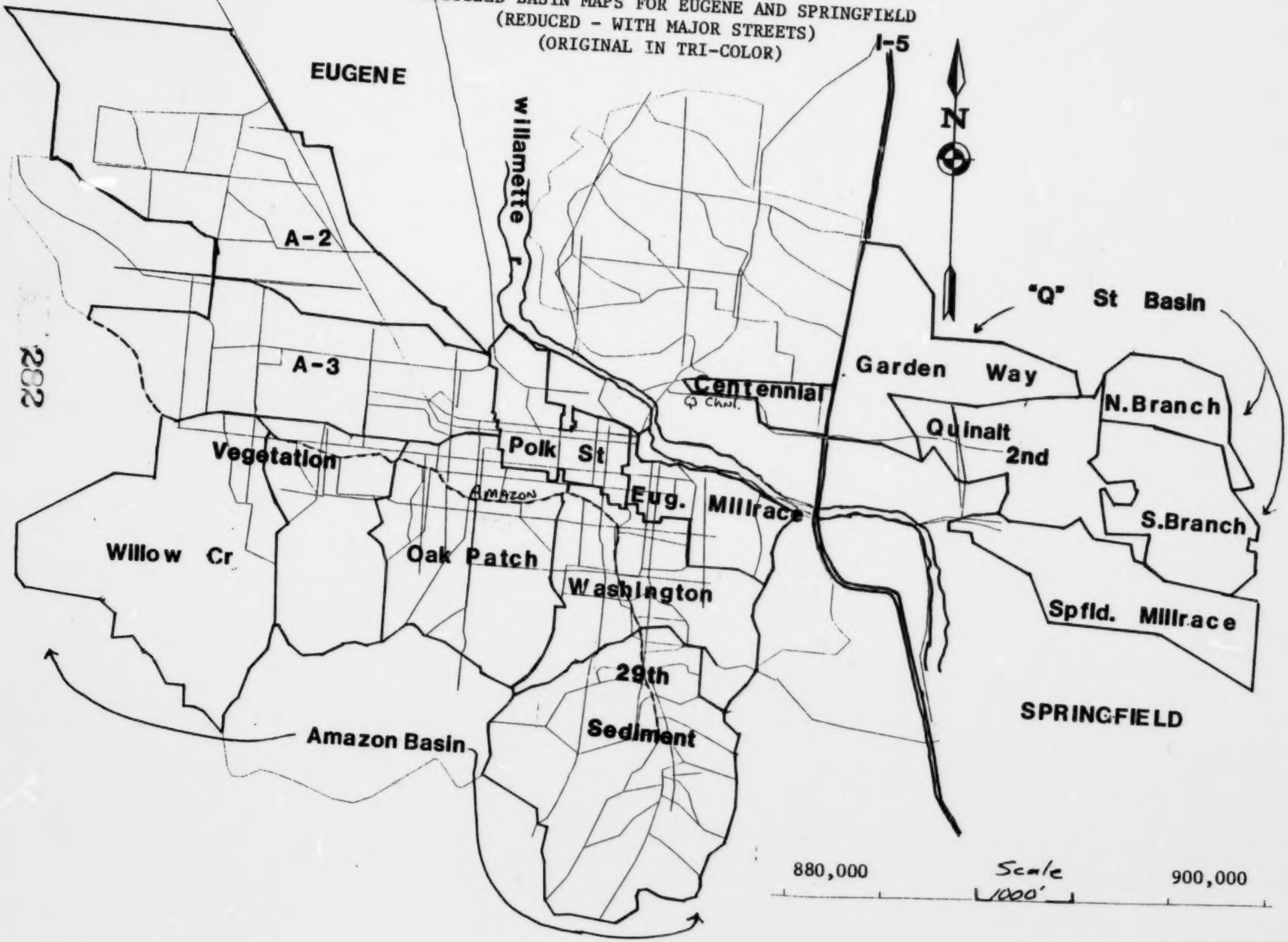
Reproduced from best available copy.

[illegible]T OF[illegible]M MO[illegible]FOR[illegible]RM S[illegible] --[illegible]SEVE[illegible]BASI[illegible] ~~LI~~[illegible]STOR
BWM



#3

DIGITIZED BASIN MAPS FOR EUGENE AND SPRINGFIELD
(REDUCED - WITH MAJOR STREETS)
(ORIGINAL IN TRI-COLOR)


I-5
N
EUGENE
willamette r
A-2
A-3
"Q" St Basin
Garden Way
Centennial
Q Chnl.
N.Branch
Quinalt
2nd
Polk St
Vegetation
AMAZON
Eug.
Millrace
S.Branch
Willow Cr
Oak Patch
Washington
Spfld. Millrace
29th
SPRINGFIELD
Sediment
Amazon Basin
880,000
Scale
1000'
900,000

APPENDIX E

PILOT STUDY REPORT FINDINGS AND RECOMMENDATIONS

CONTENTS

Street Sweeping Pilot Study

Biological Reconnaissance of an Urban Drainage System

Control of Urban Runoff Pollutants Through Vegetation Management

Sediment Trap Pilot Study on Amazon Channel

STREET SWEEPING PILOT STUDY
SPRINGFIELD-EUGENE, OREGON

Gerritt Rosenthal

Lane Council of Governments
Nationwide Urban Runoff Program
January 1982

ABSTRACT

A limited analysis of the efficiencies of street sweeping for the purpose of removal of pollutants impacting urban runoff was carried out in Springfield, Oregon in 1980. The tests were bimodal in two directions, that is, in comparing before and after conditions involving a once-over pass of a regenerative air vacuum sweeper, and in terms of a comparison of two streets with similar location but different traffic densities. Tests were performed only for normal frequency sweeping (3 x per week) situations. Total mass, particle size distribution and limited heavy metal content analyses were performed. The results indicated that a single pass with well maintained equipment can characteristically remove over 60 percent of particulates in size distributions of <63, 63-417, 417-2000 and >2000 microns, and that benefits to air quality from removal of the smaller particle sizes may be similar to the water quality benefits. Heavy metals appear to be nearly evenly dispersed in the street litter. Buildup rates indicate that frequency of sweeping should be geared to both traffic density and velocity. It appears that an ongoing program with a 2-3/week frequency can be quite effective in keeping street loadings low and in optimizing sweeper efficiency.

I. GENERAL CONCLUSIONS AND RECOMMENDATIONS

In September 1980, a limited street sweeping test series in downtown Springfield resulted in the following general CONCLUSIONS:

- Street sweeping can be an effective means of removing particulate material that would otherwise contribute to both air and water pollution.
- A regular and fairly frequent cleaning schedule is most desirable since it may allow equipment to operate at maximum efficiencies that can approach 90 percent removal.
- Efficiency of removal depended somewhat on particle size but even with particle sizes <63 microns, removals averaged greater than 55 percent.
- Street sweeping frequency should vary with traffic density, among other things, with a frequency of 2-3/week being optimum for major arterials in the downtown commercial areas.
- Street sweeping will not remove all street materials but will leave a small base load of about 20 lb./curb mile under all conditions.
- Mechanical sweepers seem to be less expensive to operate but vacuum assisted sweepers appear to be a significant improvement over standard mechanical sweepers in terms of removal efficiency, using national data on mechanical sweepers for comparison.
- Vacuum sweeping appears to be moderately effective at removing loads of trace metals such as lead and zinc.

As a result of these conclusions, the following RECOMMENDATIONS seem appropriate:

1. Continue the current sweeping program in all downtown and commercial areas of Springfield at 2-3/week for arterial streets and 1-2/week for connector streets.
2. Allocate the costs of street sweeping between three benefits: Aesthetics, water quality and air quality. This allocation should vary to some extent with the surrounding land use.
3. Replacement equipment should be of the regenerative air/vacuum sweeper type in order to achieve greatest pollution control.
4. Periodic and limited parking restrictions should be considered for major arterials to increase the efficiency of the cleaning effort.
5. Additional studies similar to the one described in this paper should be performed in residential and industrial areas to clarify the optimal program frequencies for these land use types.

BIOLOGICAL RECONNAISSANCE OF AN URBAN DRAINAGE SYSTEM: AMAZON CHANNEL EUGENE, OREGON

George P. Saunders

Lane Council of Governments
208 Water Quality Program
Nationwide Urban Runoff Program

March 1982

287

ABSTRACT

A biological inventory and analysis of two community assemblages (periphyton and macroinvertebrate) in the urban Amazon Channel system (Eugene, Oregon) was conducted from June through September, 1980. The macroinvertebrates were analyzed with respect to functional groups (Cummins, 1974), diversity and types of organisms. The periphyton were colonized on an artifical glass substrate and tested for chlorophyll, organic and nonorganic composition, diatom types and diversity. Results indicate that the Amazon Channel carries a large detrital base of Fine Particulate Organic Matter and a high degree of suspended inorganic matter. The Amazon is also moderately to highly productive, and a moderately perturbed or stressed system.

CONCLUSION

All analysis of the data effectively characterize the Amazon Channel as a moderately perturbed or stressed system. The term "pollution" is not used as it has become more of a vernacular statement and thus of questionable value in expressing water quality. The following summary of the analyses performed is offered to illustrate the consistency of the data and type of stresses experienced.

1. Macroinvertebrates are dominated by collector-gathers and "tolerant" genera indicating a large detrital base of Fine Particular Organic Matter and some degree of organic enrichment.
2. Periphyton analysis indicates that the Amazon Channel experiences a high degree of clay and silt depositional stress, moderate to high productivity and a noticable degree of organic enrichment (provided that the Autotrophic Index can be interpreted as such).
3. Diversity calculations suggest that the waters of the Amazon Channel are slightly-moderately "polluted".
4. Water chemistry data substantiate these findings by identifying a stressful system subjected to periods of oxygen depression and high concentrations of suspended particulate, heavy metals and other toxins.

CONTROL OF URBAN RUNOFF POLLUTANTS THROUGH VEGETATION MANAGEMENT

A Pilot Study on Amazon Channel
Eugene, Oregon

Rebecca A. Kreag
and
Gerritt Rosenthal

Lane Council of Governments
208 Water Quality Program
EPA Nationwide Urban Runoff Program Study

March 1982

ABSTRACT

Vegetation management was investigated as a means of improving water quality in an urban drainage channel in Eugene, Oregon. Cattails (*Typha latifolia*) comprise a major portion of the vegetation in the lower channelized Amazon Creek. Potential benefits of nutrient and metals uptake by native vegetation and methods of managing *Typha* crop were studied. Management procedures included flow dispersion and harvesting of *Typha* in late spring and fall. Extensive water quality data were collected along with *Typha* standing crop, areal cover, and tissue metals concentrations. The *Typha* contained one to four percent of the annual nitrogen and phosphorus load passing into lower Amazon (based on literature tissue concentrations). However, 80-95 percent of the annual load occurs during winter when plants are dormant. *Typha* contained the equivalent of 56-80 percent of the nitrate nitrogen that passed by during the growing season and 11 to 17 percent of the phosphorus. Metals in *Typha* tissue accounted for less than one percent of the annual runoff load. Water quality improvements in dissolved oxygen, nutrients and metals were recorded for both a management Test section and a Control section of the study area and confirmed the value of channel vegetation. Fall *Typha* growth and harvesting appear to be effective methods of seasonally removing nutrients from urban runoff. However, twice per year harvesting was detrimental. Late spring harvesting retarded *Typha* growth. Water level increases necessary for flow dispersion inhibited growth because the cattails could not survive in deep water. Additional site preparation and design work could reduce that impact. Costs and benefits of *Typha* harvest and management depend on influent water quality, the total area of *Typha* habitat, site preparation needs and harvesting costs and the level of water quality improvement required.

CONCLUSIONS

- Urban drainages in Eugene consist of long lineal wetlands dominated by a few species of aquatic plants. *Typha latifolia* appears to be predominant in biomass but *Polygonum hydropiperoides*, *Sparganium angustifolium*, *Potamogeton crispus*, *Leersia oryzoides* and *Phalaris arundinacea* also occur widely.

- The channel marsh systems contain a diverse and biologically active system of periphyton, macroinvertebrates and vertebrates. Overall, the biological system shows a moderate level of pollution, but it is subject to periods of severe stress from pollution events. Toxic spills may have a more adverse effect on the biota than general urban runoff quality in the Amazon Channel.

- Summer periods see multiple use of the drainages for parkways, fish and wildlife habitat and aesthetics. Storm drainage and flood control are the critical uses during winter.

- Naturally occuring vegetation and biological activity in an "open" drainage system provide substantial water quality benefits for urban runoff, including reduced concentrations of nutrients, metals, non-filterable residue, chemical oxygen demand, coliform bacteria and increases in dissolved oxygen. Improvements were not solely the result of *Typha* growth.

- Following passage through a four-kilometer naturally vegetated reach, mean water quality levels in the Amazon Channel improved to within State surface water standards (except for fecal coliform bacteria).

- The *Typha* growth period is from April through mid-September, with die-off in November. Highest growth rate occurred in May and early June, with maximum biomass occurring in mid-September.

- Without any management, *Typha latifolia* in the Control section covered an average of 40 percent of the Amazon Channel base. All but 5 percent of the channel base was vegetated by some wetland species by late summer.

- The peak mean above ground biomass of *Typha* in the Control section was 1573 g/m². *Typha* beds in the Test section only produced about half the biomass of unharvested plants.

- Nutrients contained in above ground *Typha* tissue probably represented only 1-4 percent of the annual load in Amazon runoff but a much higher proportion of the growing season load (11-80 percent). Metals contained in *Typha* tissue were insignificant compared with the total load (<.1 percent).

- A long-term study of macrophyte harvest may show benefits that could not be detected in a single season, such as removal of sufficient material from the sediment to cause a shift in chemical equilibrium that would result in even greater water quality improvement.

- Harvest of *Typha* in early season (June) appears to stunt growth and deplete its standing stock in future seasons. The removal of *Typha* did not have immediate effects on growth of other plants.

- Harvest of Typha is feasible by manual methods but appears to cost in the range of $500-800 per acre and hence, is not cost effective without special designs and equipment. Harvest can be expected to remove 85-95 percent of the standing crop with proper design.

- Care must be taken in altering water level to remain within the depth limitations of the species of interest. Typha latifolia do not generally grow in water deeper than 38 cm. Other species should be selected for management if water level must exceed that depth.

- Tissue analysis was too variable to establish whether submerging Typha bases increased tissue concentrations of metals. It may depend on the metal. Iron showed the greatest difference, with substantially higher concentrations found in submerged stalk plants.

- Fern Ridge water quality problems are not primarily related to nutrients and organics but more to suspended sediments. Vegetation harvest, therefore, is not presently essential to protect the reservoir.

RECOMMENDATIONS

- Drainage channel wetland vegetation, especially Typha beds, should be maintained as part of a natural BMP to control and treat urban runoff. Channel vegetation should only be removed by dredging on a periodic basis, as needed, to remove accumulated sediments. This natural treatment is an important benefit of an "open" drainage system.

- Dredging of small channel sections should be scheduled annually and completed as early in the summer as possible (prior to mid-July) to enhance natural revegetation. The present practice of dredging long stretches of channel every 4 to 10 years may dramatically reduce desirable vegetation species and the consequent water quality improvements for one or two years. The present practice in lower Amazon Channel of leaving an island, provides a seed pool for reestablishing vegetation. If the islands were to be removed, annual dredging could be done in short segments (e.g., one-half mile) to help encourage revegetation.

- Active Typha management by flow dispersion and harvest in the Amazon Channel is not recommended at this time because of the limited downstream benefits and because the unmanaged plant growth is very productive.

- Cities with urban runoff discharging into ponds, lakes or other waters sensitive to enrichment should examine the potential of optimizing wetland growth. Typha marsh creation is possible, as well as Typha harvest. Several references are available for designing such programs. The potential methods, costs and benefits of various levels of vegetation management should be given serious consideration as an urban runoff BMP. Present channel maintenance practices could also be evaluated for their effect on beneficial channel vegetation.

- Channel access is critical to any maintenance program. Major channels, such as the Amazon, should have improved access to the channel base, as well as to the banks to enhance management options.

SEDIMENT TRAP PILOT STUDY ON THE AMAZON CHANNEL, EUGENE, OREGON

Subreport

Gerritt Rosenthal
and
Rebecca A. Kreag

Lane Council of Governments
208 Water Quality Program
EPA Nationwide Urban Runoff Program
March 1982

ABSTRACT

A limited size sediment trap on the Amazon Channel in Eugene, Oregon was tested for sediment accumulation and water quality impacts. The test site size (2500 cu. ft.) was limited to detention times of about one-half hour at low flows and less than one minute at storm flow. Monitoring was carried out during the 1980-1981 water year which included a single winter high flow season. The trap showed little or no beneficial impact on water quality but proved to be moderately effective at trapping sediments greater than 0.425 millimeters in diameter. Difficulties in maintenance demonstrated that equipment access should be a major design consideration if maintenance costs are to be kept low.

VI. RESULTS AND CONCLUSIONS

The sediment trap study as finally carried out was somewhat of a disappointment due primarily to a series of field problems that constrained the size of the test area. Nonetheless, several aspects of the study appear instructive and interesting, both in regard to instream sediment collection as well as in comparison to other management practices on urban channels.

Since flows on open storm channels in Eugene tend to be erratic with a few high-peak flows in the November-February period which may be 100-500 times greater than background flows, the conclusions of this study must be understood as applying to a flow regime that is considerably different than that found in eastern portions of the country. Many smaller storm peaks occur throughout the October-June period with peak flows only 5-50 times greater than background flows. These moderate-flow conditions are repeated in the summer (July-September) but with a very reduced frequency. The results from this sediment trap pilot study should be extrapolated to other situations only if due allowance is made for the increased duration of Northwest winter storms and for the fact that the sediment control maintenance is not likely to have critical impacts during the high-use summer recreation period, as might be the case in other climates. There is in the Northwest sufficient springtime opportunity for maintenance of facilities between major sediment production and the summer recreation period.

A. Findings

- Sediment loads are primarily carried by the few, large, near-flood flows when settleable materials concentrations are 2-4 times greater than during background or moderate-flow conditions. These peak flows account for over 65 percent of the annual runoff, hence storm flows account for over 80 percent of the total annual sediment load (See Footnote 2).

- Even a small sediment trap with retention times of less than one minute at high flows may be able to collect 10-15 percent of its volume of sediments in a single season.

- Over 80 percent of the sediments collected in a small trap are greater than .425 millimeters in diameter. About half of this sediment is larger than 2.0 millimeters in diameter. Most of the collected material appears to be refractile and "stoney."

- No significant water quality benefits were detected on passage through the sediment trap, although aeration undoubtably occurred below the trap structure. This contrasts with steady quality improvements on passage through a natural marsh/vegetation system.

- Easy maintenance of the pilot study was precluded by existing structures.

- It is possible to design sediment traps such that the cost of removal of sediments is less than 0.1 person day per cubic yard (approximately $13-15 per cubic yard).

- Sediment accumulation during the summer appeared to be slight.

B. Conclusions

- Sediment traps can be made into a useful management practice in high sediment production areas.

- Such traps must be designed for easy equipment access to facilitate periodic cleaning. In the Northwest, annual or biannual cleaning is indicated. Cleaning in mid winter is indicated with a second cleaning in early spring or late fall.

- Although design will vary with flow, in areas with high peak winter flows, designs should allow a volume equal to at least 10 times (10 seconds) the annually expected peak flow in cfs. Optimum size is probably closer to triple this capacity which would allow sufficient retention time (30 seconds) for settling of intermediate size (.5-1 millimeter) particles.

- Because of the relatively non-aesthetic nature of sediment traps as well as their lack of demonstrated beneficial water quality impact, it is not recommended that traps be made into large holding ponds. Emphasis on sediment collection should be on small or medium-size traps and their use does not have to be directly combined with vegetation management or flood control. Design emphasis should concentrate on easy access, energy reduction and localized aesthetic benefits such as reflecting pond design, screening plantings, etc.

- A series of sediment traps on the Amazon Channel would be useful in reducing the dredging maintenance needs at points lower in the basin. Suggested sites include (1) the current 29th Street location but with expansion and redesign: (2) a site below the concrete channel section above the Fairgrounds and (3) a site near the West 11th Street bridge crossing.

Footnotes

[1] The ratio of trap volume to inflow provides an average "transit" or "detention" time. If the simplifying and conservative assumption is made that this flow is not turbulent, Stokes Law would predict settling rates in the 0.1 to 1 cm/sec range for particles between .1 and .25 millimeters. With a trap depth of 3 feet and assuming that a particle would have to settle at least one half the depth to avoid spillway effects (45 cm), retention times less than 45 seconds would be ineffective for particles settling less than 1 cm/sec.

[2] Yearly flow and mass loading analysis of various constituents at sites further downstream indicates that approximately 60-65 percent of the yearly flow volume occurs during major storm events when sediment concentrations (non-filterable residue) are 2-4 times background levels. Using the lowest of these storm concentrations, 80+ percent of the load occurs during storms.

APPENDIX F

ORDINANCES AND IMPLEMENTATION

CONTENTS

Design Factors for Storm Drainage and Erosion Control in Eugene and Springfield

Draft Industrial Site Drainage and Pollution Ordinance

Executive Summaries of Individual Reports on Urban Stormwater Runoff Financial Management Program

Springfield Storm Drainage User Fee and Ordinance Proposals

DRAFT
DESIGN FACTORS FOR STORM DRAINAGE AND EROSION CONTROL IN EUGENE AND SPRINGFIELD

Prepared By

Jack Markowski
for
Lane Council of Governments
125 East 8th Avenue
Eugene, Oregon 97401

October 1980

TABLE OF CONTENTS

Page

INTRODUCTION 1

I. GOALS, OBJECTIVES AND POLICIES OF THE METROPOLITAN AREA GENERAL PLAN 3

- A. Environmental Resources 4
- B. Willamette River Greenway, River Corridors and Waterways 5
- C. Environmental Design 6
- D. Public Utilities, Services and Facilities 7

II. SPRINGFIELD'S POLICIES ON DRAINAGE - RELATED DESIGN CRITERIA 8

- A. General Statements of the Springfield Code 8
- B. Land Division and Land Development 8
  - 1. Land Division 9
    - a. Minor Partitions 11
    - b. Major Partitions 12
    - c. Subdivisions 12
    - d. Planned Unit Developments 14
  - 2. Site Plan Review 16
  - 3. Review of Building Permit Applications 17
- C. Other Design Controls 18

III. EUGENE'S POLICIES ON DRAINAGE - RELATED DESIGN CRITERIA 19

INTRODUCTION

This report concerns design factors for storm drainage and erosion control in Eugene and Springfield. It addresses the procedures and the criteria used in the review of applications for land division, land development, and building permits in the two cities.

This is the third in a series of four reports on storm drainage and erosion control ordinances in Eugene-Springfield. The previous two reports have addressed: (1) personal behavior ordinances relating to urban runoff; and (2) storm drainage management and financing. The fourth report will deal with drainage and erosion control.

The emphasis of this report is on staff review of applications rather then on public hearing and approval by the Planning Commissions and City Councils. Although the Planning Commissions and City Councils are guided by general policy statements regarding storm drainage and erosion control, they do not perform formal, technical reviews of applications. Rather, they concentrate on the general policies (with information from the staff reports) and on specific concerns of affected citizens.

Enginnering standards, such as required street widths and materials composition for driveways and sidewalks, are, of course, very important to storm drainage and erosion control, but these are not addressed in this report.

The report is in three sections:

1. Goals, Objectives and Policies of the Metropolitan Area General Plan;
2. Springfield's Policies on Drainage-Related Design Criteria;
3. Eugene's Policies on Drainage-Related Design Criteria.

I. GOALS, OBJECTIVES, AND POLICIES OF THE METROPOLITAN AREA GENERAL PLAN

The Metropolitan Area General Plan is the comprehensive plan for Eugene and Springfield. Its goals, policies, and objectives should be the general basis for ordinances and regulations within the two cities. Topics addressed by the General Plan pertinent to this report include open space, protection from natural hazards, water quality and minimization of problems associated with water quality, restrictions on hillside development, retention of stormwater, and vegetative cover. It is the obligation of the cities by ordinances, regulations and procedures to carry forth these general goals.

The following goals, objectives and policies from the Genreral Plan are relevant to water quality, drainage and erosion control.

A. Environmental Resources

GOALS

Protect valuable natural resources and encourage their wise management, proper use and reuse, reflecting their special natural assets.

Maintain a variety of open spaces within and on the fringe of the developing area.

Protect life and property from the effects of natural hazards.

Provide a healthy and attractive environment for the metropolitan population.

OBJECTIVES

1. Maintain the benefits associated with environmental resources in an urban setting. Those resources include agricultural lands, clean air and water, forest lands, sand and gravel deposits, scenic areas, wildlife and wildlife habitate and vegetation.

2. Maintain the livability of the metropolitan area by integrating open spaces and urban development by planning for a variety of public and private open spaces, and by considering the natural environment when making planning decisions.

3. Improve and maintain air and water quality to meet acceptable state and local standards.

4. Minimize problems associated with water quantity.

6. Prevent damage to life and property associated with flooding and problem soils.

POLICIES

1. Springfield, Lane County and Eugene shall consider downstream impacts when planning for urbanization, flood control, urban storm runoff, recreation and water quality along the Willamette and McKenzie Rivers.

2. Development shall be prohibited within the floodway.

3. When development is allowed to occur in the floodway fringe, local regulations shall control such development in order to minimize the potential danger to life and property. Within the urban service area, development should result in in-filling of partially developed land.

4. Local government shall require site specific soil surveys and geologic studies where potential problems exist. When problems are identified, local governments shall require special design considerations and construction measure be taken to offset the soil and geologic constraints present, to protect life and property, and to protect environmentally sensitive areas.

11. Metropolitan goals relating to scenic quality, water quality, vegetation and wildlife, open space, and recreational potential shall be given a higher priority than timber harvest within the urban growth boundary.

14. Local government shall develop plans and programs which carefully manage development on hillsides and in water bodies and restrict development in wetlands in order to protect the scenic quality, water quality, vegetation and wildlife values of those areas.

15. In order to improve water quality and quantity in the metropolitan area, local governments shall consider developing regulations or instituting programs to:

    a. Increase public awareness of techniques and practices private individuals can employ to help correct water quality and quantity problems.

    b. Improve management of industrial and commercial operations to reduce negative water quality and quantity impacts.

    c. Regulate site planning for new development and construction to better control drainage and erosion and to manage storm runoff.

    d. Increase storage and retention of storm runoff to lower and delay peak storm flows.

    e. Utilize natural and mechanical treatment systems to provide treatment for contaminated runoff waters.

    f. Reduce street-related water quality and quantity problems.

    g. Minimize use of toxic substances.

18. When planning for and regulating development, local governments shall each continue to consider the need for protection of open spaces, including those characterized by significant vegetation and wildlife. Means of protecting open space include, but are not limited to, outright acquisition, conservation easements, planned unit development ordinances, streamside protection ordinances, open space tax deferrals, donations to the public, and performance zoning.

19. Eugene shall maintain and improve and Springfield shall adopt hillside development regulations.

21. Local governments shall develop policies and local controls for protection and management of wetland areas.

B. Willamette River Greenway, River Corridors and Waterways

GOAL

Protect, conserve and enhance the natural, scenic, environmental and economic qualities of lives and waterway corridors.

OBJECTIVES

1. Encourage use of river and waterway corridors to fulfill open space, recreation, and resource protection needs.

2. Ensure that development occurring within river and waterway corridors is responsive to and provides protection of these valuable natural assets.

3. Encourage, where appropriate and in keeping with Greenway goals, development that respects the quality of rivers and waterways, and provides a variety of opportunities for enjoyment of those resources by the public.

4. Encourage coordinated water planning and the development of the area's waterways, where appropriate as part of the area's open space and park system.

POLICIES

5. New development that locates along river corridors and waterways shall be limited to uses that are compatible with the natural, scenic, and environmental qualities of those water features.

C. Environmental Design

GOALS

Secure a safe, clean and comfortable environment which is satisfying to the mind and senses.

Encourage the development of the natural, social, and economic environment in a manner that is harmonious with our natural setting and maintains and enhances our quality of life.

Create and preserve desirable and distinative qualities in local and neighborhood areas.

OBJECTIVES

4. Shape development to suit natural conditions as much as possible.

5. Enhance views and public use of river corridors, drainageways, and prominent topographic features such as ridgelines and buttes, within the jurisdiction of the Metropolitan Plan, when consistent with other planning policies.

POLICIES

2. The utilization and retention of natural vegetation, natural water features, drainageways and landscaping shall be strongly encouraged as part of all urban development.

3. The planting of street trees shall be encouraged.

3C5

6. *Local jurisdictions shall carefully evaluate their development regulations to ensure that they adequately account for environmental design considerations, such as, but not limited to site planning and landscaping of developments.*

D. Public Utilities, Services, and Facilities

GOAL

Provide and maintain public utilities, services, and facilities in an orderly and efficient manner.

OBJECTIVES

4. *Optimize the utilization of existing facilities.*

5. *Generally reduce public subsidy for utilities and facilities in new development.*

6. *Provide at least the minimum level of key urban services to all urban development within the metropolitan area.*

POLICIES

1. *In general, the amount of public subsidy for public utilities, services, and facilities, such as schools, sewers, and streets shall be reduced. New development should help support construction of new public utilities, services and facilities through methods such as systems development charges, taxes, land donation, or payment of fees in lieu of land donations. This does not preclude subsidy where a development will fulfill goals and recommendations of the Plan determined by the local jurisdiction to be of particular importance or concern.*

12. *Encourage the use of water treatment, solid waste, and sewage disposal systems that are energy efficient and environmentally sound.*

II. SPRINGFIELD'S POLICIES ON DRAINAGE-RELATED DESIGN CRITERIA

A clear review of Springfield's policies on drainage-related design criteria is difficult because of the differences between: (1) the current Springfield Code and the Zoning Code (what is legally enforcable); (2) what is actually done on code enforcement practice; and (3) proposed replacement portions of the the two codes.

Rather than solely focusing on any one of these factors above, this paper attempts to give an overview of all three in their relation to the subject. Though this approach may be somewhat tedious and confusing, it seem to be the only approach to give a complete, accurate overview of current Springfield policies and practice.

A. General Statements of the Springfield Code

Before proceeding with the analysis of Springfield's policies on land division and land development, it is useful to list certain general Code sections which have design implications. These sections prohibit drainage water from a structure from flowing across public thoroughfares (5-11-5), require that polluted waters be discharged only into the public (or an approved private) sewer system (2-10-13), declare the City's authority over drainage ditches, and make it unlawful to obstruct or change the water flow in these ditches (5-14-14). These Code sections have been previously listed in the report on personal behavior ordinances. (Markowski, Sept. 1980)

5-11-5 Water on Public Thoroughfares: It shall be unlawful for the owner , lesee, or occupant of any building or structure to suffer or permit rainwater, ice, or snow to fall from the building or structure upon any street, alley or sidewalk or to flow across any such sidewalk, and every such owner, lessee, or occupant shall at all times keep and maintain in a proper state of repair, adequate drainages or a drainage system sufficient to carry to the street gutter or to a storm sewer any overflow water accumulating on the roof or about the building.

2-10-13 Discharge of Sewage and Waste: Sanitary sewage, industrial waste, and other polluted waters may be discharged only into the public sewer system of the city or into a private sewer system approved by the city.

5-14-14 Ditches: The street department of the city shall be in charge of drainage ditches, and it shall be unlawful for anyone to change or obstruct the flow of water in such a ditch, except under the supervision and direction of the street department.

B. Land Division and Land Development

Generally, there are three steps in the land division and land development process at which a review of drainage may take place:

1. Land Division -- This includes applications for minor partitions, major partitions, and subdivisions. It refers only to the division of one parcel into a number of smaller parcels.

307

2. Site Plan Review -- This is a subjective review of proposed site development for all sites except one- and two-family residences.

3. Review of Building Permit Applications -- This refers to the review that ensures that the structure built on the site conforms to certain standards.

1. LAND DIVISION

Land Division is addressed in Chapter 10 of the Springfield Code. The purpose of this Chapter varies somewhat between the current Chapter 10 and its proposed revision although both versions address pollution, drainage and flooding.

Current Chapter 10

10-4-1 Purpose: The purpose of this article shall be to provide rules, regulations and standards governing the division of land, partitions and subdivisions in order to accomplish the orderly development of land within the city in conformity with adopted plans, policies and goals; to minimize street congestion, secure safety from fire, flood and geological hazards; to guard against pollution and other detrimental effects upon the environment; to provide for adequate light and air; to prevent overcrowding; to provide adequate consideration of the impact upon the city and surrounding area to the location of subdivisions and other partitions; and to facilitate and provide for adequate transportation, water supply, sewage disposal, drainage, education, recreation and other public services and facilities.

Chapter 10 Proposed Revision

10-1-2 Purpose and Intent: The City Council hereby finds that it is necessary in order to accomplish the orderly development of land within the City to provide rules, regulations and standards to govern the approval and development of subdivisions and partitions as well as the development of existing properties, taking into consideration; (1) application plans, policies and goals; and (2) the locations of proposed subdivisions, partitions, and developments of existing properties, as well as their impact on the surrounding area and the entire City.

It is the intent of this ordinance to minimize street congestion, ensure protection from fire, soils and geological hazards, pollution and other dangers, to provide adequate light and air, to prevent overcrowding of land, to encourage energy conservation, and to facilitate adquate provisions for transportation, water supply, sewage disposal, drainage, education, recreation and other public services and facilities.

Current Standards

In the current Chapter 10, the platting and mapping standards for all land divisions include provisions that:

10-4-9(5) the layout of streets give recognition to surrounding topography.

10-4-11(3) and 10-14-13 Easements may be required for stormwater sewers and access thereto and on land subject to accumulations of water or travesed by any water course.

10-4-16 Areas subject to slippage, flooding, or other natural hazards shall not be divided in a manner dangerous to the public.

10-4-17(1) Specifications for drainage facilities and slope easements shall be established by the city engineer.

10-4-17(6) Grading shall be done and drainage facilities constructed by the land divider as are adequate for proper drainage and for preservation of healtful and convenient surroundings and conditions for residents.

Proposed Standards

These concerns have been replaced in the proposed Chapter 10 revision with the following provisions:

10-4-2 Drainage facilities shall be constructed as in 10-4-17(6) above.

10-4-1(3) Storm water runoff shall be collected and conveyed by an approved system. Runoff computations and drainage facilities shall anticipate and accommodate full future development within the drainage area.

10-4-3(2) Drainage channels and conduits shall have the following capacities:

(a) Major drainage channel - 10 year frequency of occurrence runoff.
(b) Secondary drainage channel - 5 year frequencey of occurence runoff.
(c) Minor drainage channel - 2 year frequency of occurence runoff.

10-4-3(3) Stormwater should be placed in conduits when gutter flow comes within one inch of the top of the curb or encroaches upon the traveled portion of the street. Storm water in channels shall be placed in closed conduits except that natural water courses endowed with significant natural beauty may be used for open drainage.

10-4-3(4) The minimum conduit size shall be 10 inches. The grade shall provide a design flow of three feet per second.

10-4-5(2) Existing healthy trees shall be preserved.

10-5-5(3) Cut and fill slopes shall be planted as directed by the Director of Public Works.

10-4-5(4) Landscaping shall be as directed by the Planning Commission or the Site Plan Review Board.

10-5-4(2) It shall be unlawful to excavate, grade or fill so as to allow dirt or debris to be washed onto another property or a street. Depositing earth, soil, rock, mud, or litter upon public roads is prohibited except when a permit has been issued.

10-5-4(3) It shall be unlawful to obstruct a drainageway, given the above set of policies, the following land division guidelines are defined except when approved by the Director of Public Works.

a. Minor Partitions

A minor partition is a land division resulting in three or less lots which does not include creation of a road or street. Minor partitions are addressed in Section 10-4-6 of the current Springfield Code and in Section 10-21 of the proposed Chapter 10 revision.

According to the current 10-4-6(1), an application for a minor partition is to be submitted on a form prescribed by the Planning Division, accompanied by a topographic map, and reviewed by the Land Development Review Committee. To be approved, the plan for the minor partition must be in harmony with the comprehensive plans and the area's zoning classification [10-4-6(1)(c)(1)].

In practice, applications for minor partitions are reviewed by the Partition Review Committee, which is composed of representatives from City departments. The application form requires information on existing drainage ways, existing structures, and unusual topography. A staff member makes a site visit and notes the slope, the existing landscaping, access to existing storm sewers, and existing site drainage. Soil reports and drainage plans are required in any areas known to have drainage problems (e.g., South Hills, Beverly Park), but this is infrequent since most minor partitions occur in flat, non-problematic areas. The object of the review is to make sure that all drainage water gets into a storm drain or ditch since storm sewer pipes are preferred to open ditches according to city policy.

The revision to Chapter 10 generally formalizes the Partition Review Committee and its current practices. In addition, however, information is required on areas subject to stormwater overflow, the direction of flow of all water courses, proposed plans for handling drainage and stormwater overflows for each parcel, and proposals for handling drainage from adjacent properties [10-2-1(2)(b)(11)(a-c)]. The general policy statements regarding drainage remain the same as in the current Chapter 10.

b. Major Partitions

A major partition is a land division resulting in three or less lots which includes the creation of a road or street. According to the current Chapter 10 (Section 10-4-7 to 10-4-8), major partitions go through the same review process as subdivisions (described below).

In practice, however, major partitions rarely occur, and when they do, they go through the same process as minor partitions.

In the revision to Chapter 10, major partitions are formally included with minor partitions in Section 10-2-1. They follow the same process and are affected by the same policies as those described above.

c. Subdivisions

A subdivision is a division of land into four or more lots. Subdivisions are addressed in Sections 10-4-7 and 10-4-8 of the current Springfield Code. The application process is in two steps: tentative plan approval and subdivision plat approval.

The tentative plan is submitted to the Planning Department which then distributes the tentative plan among city agencies for review [10-4-7(1) and (3)]. The information required on the tentative plan includes: a topographic map; the location of areas subject to inundation or storm water overflow; all areas covered by water; the location, width, and direction of flow of all water courses; the existing and proposed uses of the property including all structures that will remain; all proposals for sewage disposal, flood control, and easements for drainage land, including profiles of drainageways; the location, size and type of any perennial plantings in public ways; predominant natural features such as water courses and their flow direction, marshes, rock outcroppings and areas subject to inudation and slipping [10-4-7(2)].

After the city agencies' review, the tentative plan is submitted to the Planning Commission. Planning Commission approval is subject to affirmative findings that the subdivision does not impede the future best use of the remainder of the property or adversely affect such remainder or any adjoining land or access thereto and that the tentative plan complies with Section 10-4-1 [10-4-7(4)]. (see page 9)

In Section 10-4-7(5), Springfield reaffirms its desire to contribute to the highest feasible level of water quality in the Willamette River in a manner that will help to maintain a reasonable supply of new housing and land for development. This section provides that the Planning Commission carefully examine proposed subdivisions that create 30 or more housing units for their impact on existing sewage treatment facilities and that approval may be contingent on provision of additional sewage treatment capacity. Subsection c, however, implies that this consideration includes only sanitary sewers; this subsection states that the whole section will be null and void when the regional sewage treatment facility (a sanitary sewage facility) is operational.

After tentative plan approval by the Planning Commission, the subdivision plan application is made to the Planning Department and approved by the Land Development Review Committee (10-4-8). This application must include the zoning and comprehensive plan designations for the property; the location of all areas covered by water; and the location, width, and direction of flow of all water courses [104-8(2)]. Approval by the Land Development Review Committee is contigent on affirmative findings that the proposal complies with Section 10-4-1 and that there is an adequate sewage disposal system to support the proposed use of the land.

In practice, the tentative plan application form provided by the Planning Department requires information including contours, areas of inundation by water and direction of flow, profiles of drainage facilities, and drainage plans (including lot grading). Subdivision plan review is carried out principally by the Land Development Review Committee, which is composed of representatives of city departments. This review is quite prescriptive and is concerned with adherence to Springfield Code 10-4-7 to 10-4-8 and the provision of urban services although there is no specific checklist for this review. Storm drainage is principally the concern of the Engineering Division of the Public Works Department. Engineering's policy is to make sure that all drainage from developments connect as directly as possible to the city's storm drainage system and that such drainage does not flow across adjacent properties.

Subdivisions may also be required to go through Site Plan Review (discussed in Section 2 below) attached as a condition of approval if there seems to be special problems such as steep slopes, rock outcrops, etc.

In the revision of Chapter 10, the preliminary subdivision plan is reviewed by city agencies and by the Land Development Review Committee before submittal to the

Planning Commission. After Planning Commission approval, the Land Development Review Committee makes final subdivision plat approval. The information required on the tentative plan includes all that is required under the current Chapter 10 plus the following: trees 12 inches or more in diameter that would interfere with the public rights-of-way and easements; approximate finished grading of each lot and top and toe of cut and fill slopes; proposed easements for drainage and for handling storm water overflow for the entire subdivision and for each individual lot; and proposals for handling drainage, including sheet flow, from adjacent properties [10-2-2(2)(6)].

Except when a preliminary report indicates that the soils quality does not require further analysis [10-5-9(4)]; the tentative plan must include areas of unstable soil or slide conditions as determined by this [10-2-2(2)(6)(24)]. The Soils and Geology Report must include: a general indication of both surface and subsurface drainage facilities necessary to secure stability of native soil or compacted fill; the location of areas which can safely be used for building sites; guidelines for proper development of the area e.g., desirable heights of cuts and fills, desirable steepness of slopes, erosion control measures, and necessary corrective measures; and an analysis of the impact of grading on adjacent development [10-5-9(1)].

Excavation and fill are governed by Chapter 29 of the Uniform Building Code [10-5-9(2)]. This chapter limits the slope of both excavations and fills to a maximum steepness of two horizontal to one vertical unless substantiating data justifying steeper slopes are submitted [2903(a)]; it requires that excavations and fill be so constructed that they do not endanger life or property [2903(a)]; it requires that provisions be made for the control and drainage of surface water around buildings [2905(f)]; and provide for positive drainage from areas underneath buildings without basements (2910).

Approval of the tentative subdivision plan by the Planning Commission must include affirmative findings that the division does not adversely affect or impede the future best use of adjacent property that the plan complies with Section 10-1-2[10-2-2(5)].

Subdivisions plat approval is granted by the Land Development Review provided, among other things, that the proposal complies with Section 10-1-2 and that there exists an adequate sewage disposal system [10-2-3(6)].

d. Planned Unit Developments

A Planned Unit Development (PUD) is a specific type of subdivision to which subdivision regulations are applied more flexibly than in other developments in order to provide for open space and a more livable environment. PUDs are addressed in Articles 21 and 30 of the current Springfield Zoning Code. The process for a PUD is as follows: The preliminary development plan and program is submitted to the Planning Director (30.02) and reviewed by the Planning Director and the Director of Public Works (30.03). The PUD must be consistent with the comprehensive plan and subdivision ordinances [30.03(c)]. The Planning Commission reviews and grants conditional approval to the preliminary plan (30.03). The final development plan and program is submitted to the Planning Director (30.06), reviewed and approved by the Planning Commission (30.08-30.09), and heard and approved by the City Council (30.10-30.11). Comtemporaneous approval of the subdivision plat under the subdivision ordinance (discussed above is also required in the PUD process (30.06).

In addition to the information required for the subdivision approval process, the PUD final development plan and program must also address landscaping. A visual landscaping plan is required for PUDs less than 25 acres; a conceptual plan only is required for PUDs larger than 25 acres [30.07(f)].

With regard to drainage and erosion control, the Zoning Code states the policy, "To the maximum extent possible the development plan and program shall assure that natural features of the land are preserved and landscapping is provided [21.04(f)]."

In actual practice, PUDs must go through the Land Development Review Committee (for subdivisions), the Planning Commission, the City Council, and the Site Plan Review Board (discussed in the next section). Sustantive review is performed mainly by the Land Development Review Committee and the Site Plan Review Board. The preliminary and final review stages (as stated in the Zoning Code) are meshed together in this process. The Site Plan Review Board is limited in its function since its review comes after the prescriptive review of the Land Development Review Committee. This severely constrains the flexibility of the Site Plan Review Board since the Land Development Review Committee provides a more restrictive review. PUDs are not used often in Springfield -- only eight have even been constructed, only one since 1978.

A revised Article 21 has been proposed to replace both Articles 21 and 30 of the Zoning Code. This revision changes the PUD review process so that the Site Plan Review Board conducts preliminary and final reviews; this Board's reviews are parallel to, rather than subsequent to (as in current practice), the reviews of the Land Development Review Committee. It is not clear how possible differences between these two reviews will be resolved.

Section 21.04(d)(2) of this proposed ordinance gives density bonuses for certain design practices in PUD development. Subsequent to a review of the proposal, L-COG 208 staff has suggested the inclusion of density bonuses for design practices which reduce the peak and/or total flow of storm water from PUDs (Memo to Rob Lilly; August 27, 1980). This suggestion has been accepted in priciple by the Springfield staff, and provisions to this effect will probably be included in the final proposal for Article 21.

2. SITE PLAN REVIEW

Site Plan Review is addressed in Article 28 of the Springfield Zoning Code. Its purpose is to "promote the orderly and harmonious development of the City, to ensure the enhancement of the City's unique character and assets, to ensure against land devaluation due to negative architectural impacts, and to safeguard the general welfare of the community (28.01)." The process seeks to encourage originality, flexibility, and innovation in site planning and development [28.01(a)].

Site Plan Review is the final step before issuance of a building permit. It is required upon application for building permits in all zoning districts (1 and 2 family dwellings are exempt except in unusual circumstances or as directed by the Planning Commission) and may be required in situations of resolution of intent to rezone, Planned Unit Developments, and conditional use permits (28.02). The required information for an application for Site Plan Review includes: landscapping, including all plants, their expected size at maturity, and ground cover; off-site public improvements and dedications, including sewers; and roof and site drainage -- the location and size of drain lines and catch basins, site grades (existing and finish), and the point of connection to City storm sewers (28.05). The building superintendent may waive the requirement for Site Plan Review if the proposed building will have no material effect on the orderly and harmonious development of the City (28.06).

The policies and standards applied by the Site Plan Review include: the preservation of the landscape -- tree and soil removal should be minimized, and trees over four inches in diameter should be retained [28.07(a)]; the building should not be detrimental to the character of the zone, will preserve property values, and will promote the City's desired direction of building development [28.09.(a)]; and the removal of surface waters shall not adversely effect neighboring properties or the public storm drainage system [28.08(d)].

In practice, Site Plan Review is applied to all PUDs and all commercial, industrial, and larger than two-family residential buildings. Most subdivisions also have Site Plan Review attached as a condition of a resolution of intent to rezone. The Site Plan Review Board is composed of members of the City staff, including division heads from the Department of Public Works.

In both subdivisions and PUDs, the intended flexibility of the Site Plan Review is limited by prior review and approval by the more prescriptive Land Development Review Committee. The information required and the standards for review closely follow Article 28. With regard to drainage, the policy is to make sure that all surface water runoff is routed directly to the storm sewer system.

3. REVIEW OF BUILDING PERMIT APPLICATION

A building permit is required to "erect, construct, enlarge, alter, repair, move, improve, remove, convert, or demolish any building or structure (9-1-2)." Springfield has odopted the Uniform Building Code (including the optional Chapter 70 on Excavation and Grading) and the Uniform Plumbing Code to regulate building construction. Chapters 29, 32, and 70 of the UBC apply to drainage and erosion control: Chapter 29, regulating excavations and fills, has been previously discussed in this report in the proposed revision to the Springfield subdivision ordinance (See Section 1-C above); Chapter 32 says that roofs may be sloped to drain water over the edges, but roof drainage water shall not be permitted to flow over public property; Chapter 70 gives detailed specifications for excavation and grading.

A plumbing permit is required to install, alter, or repair any plumbing, drainage, or sewer system, or any apparatus for the furnishing of water to, or the disposing of drainage and sewage of any kind from, within, on, or about any building within the City (9-4-4). The Uniform Plumbing Code, however, addresses only the quality of materials and the necessary size and slope for proper drainage.

The general consideration followed by the building department for the building permit review are as follows:

- All drainage should be routed to a street, bar ditch, or storm sewer. (Some State highways have the maximum amount of storm water runoff and can take no more water routed directly to them.)
- Natural drainage patterns should not be altered.
- Reinfiltration of storm water is not encouraged. The object is to route all water from impervious surfaces directly to the storm drainage system.
- Some minimum floor elevations and raised foundations (compacted rock or bar run) are required so that water flows away from buildings.
- Panhandle lots present a problem in getting their runoff out to the storm drainage system.

There is some confusion as to whether or not Springfield (or any City) has the power to enact and enforce standards different than those in the Uniform Building Code (which is adopted by the State). It is the opinion of the State Department of Commerce (the agency that administers the code) that the Uniform Building Code sets minimum standards for construction and that cities may enact and enforce stricter standards. This opinion follows the Oregon Supreme Court ruling in Oregon vs. Troutdale [281OR.203(1978)]. There may still be some question, however, as to whether alternative drainage methods represent stricter standards and can thus be enacted and enforced by Springfield. There is currently some contradiction between city policies to maintain natural drainage and to route drainage into storm sewers.

C. Other Design Controls

There are two other areas which have a design impact on drainage: the Flood Plain sub-district and the City Standard Specifications.

The Flood Plain sub-district is addressed in Article 3 of the Springfield Zoning Code. It provides for a zoning sub-district to be applied in areas subject to a one percent or 100-year flood. Its purpose is to minimize property loss, danger of injury, and health hazards. In such areas, the City may control floor elevations to prevent damage from flooding.

Although not directly addressed in this report, the City of Springfield Standard Specifications also have an impact on drainage and erosion control. These specifications address the materials, the design, and the construction process for sidewalks, curbs, gutters, driveways, sanitary sewers, and storm sewers. Of particular importance are Chapters 2, 11, 12, 13 and 40.

III. EUGENE'S POLICIES ON DRAINAGE-RELATED DESIGN CRITERIA (AN OUTLINE)

The following outline provides a basis for an analysis of Eugene's policies on drainage-related design criteria paralled to the analysis of Springfield's policies in the previous section.

A. General Statements of the Eugene Code

See 6.065, 6.075, 7.070, 4.975, 6.305.

B. Land Division and Land Development

See Chapters 8 and 9 and South Hills Study.

1. Land Division - See Chapter 9.

The Eugene city engineer generally prefers closed pipe for storm drainage and is wary of open ditches. This is principally because of the expense in cleaning open ditches (primarily of overgrown vines). The City's mosquite control program also prefers clsoed pipes over open ditches.

a. Minor Partitions

See 9.030 and Development Standards of South Hills Study.

b. Major Partitions and Subdivisions

See 9.035 to 9.080 and Development Standards of South Hills Study.

c. Planned Unit Developments

See 9.508 to 9.520 and Development Standards of South Hills Study.

PUD storm drainage is put in closed pipes unless the owners' association has an agreement to maintain an open channel.

2. Review of Building Permit Applications

See 7.065, 8.025 Eugene Code.

See Uniform Building Code Chapters 29, 32, and 70. Note: Eugene has not officially adopted Chapter 70; it is regarded as good practice.

See Development Standards of South Hills Study.

The guiding principles with regard to drainage in the review of building permit applications are to guard the foundation against erosion and to prevent the drainage of stormwater onto adjacent property.

Although much of the soil is relatively impervious, on-site reinfiltration of roof drainage is acceptable where appropriate.

Driveways in one- and two-family dwellings may be made of semipervious materials but it is not specifically encouraged.

For Plumbing, See Eugene Code 8.555 to 8.69 and 8.579.

C. Other Design Controls

Flood Hazard Sub-district. See 9.268(e) and 9.604 to 9.606.

Site Review Sub-district. See 9.686 to 9.690.

Engineering specifications. See 7.085, 7.125 to 7.150, 7.360 to 7.435 and 9,045, 9.085, 9,095, 9.556 and 9.586 to 9.592.

Copies of selected materials are attached.

DRAFT INDUSTRIAL SITE DRAINAGE AND POLLUTION ORDINANCE

I. PURPOSE

It is the purpose of this ordinance to encourage the cost-effective control of surface drainage and runoff pollution from industrial site operation and storage areas by:

A. Confining hazardous and noxious wastes to the industrial sites upon which they were created or stored.

B. Lessening erosion, storm runoff and spill pollution through spill control and the design and maintenance of structures and devices for runoff control including maintenance procedures.

C. Avoiding the increase in flood hazard and associated costs of expanding public drainage facilities.

D. Conserving the taxable value of property by the enhancement of the environmental character of streams and drainageways in the city.

E. Promoting the goals and policies of the Eugene-Springfield Metropolitan Area General Plan, which deal with water quality and public facilities.

II. FINDINGS

The following water quality pollution incidents, which have occurred in the Eugene-Springfield metropolitan area since 1970, shall serve as Findings of Fact supporting the importance of this ordinance to the safety, health and general welfare of Eugene and Springfield residents:

A. In May 1980, several hundred gallons of sulfuric acid contaminated Amazon Creek from its West 11th Avenue channel to Fern Ridge Reservoir. This acid, created by a metal plating waste discharge, caused a verified fish kill of over 100 fish.

B. In February 1981, a spill of urea-formaldehyde mixture into the Q Street drainage channel near the Mohawk Plaza resulted in a limited fish kill.

C. Excessive oil and grease from heavy equipment facilities, organics and heavy metal concentrations from industrial runoff have frequently been detected in the A-3 drainage channel at Bertelsen Road and Wallis Road. Occasional major oil spills, as in 1979, have occurred from industrial oil sumps.

D. Numerous industrial site runoff and spill incidents have occurred from Springfield lumber yards, resulting in the contamination of ditches on South A and South 28th Streets in Springfield. Other industrial site runoff problems have created excessive oil, grease and organic pollution in ditches along Marcola Road.

E. There has been a history of spills and inappropriate drainage from acid plating facilities at irrigation pipe manufacturing companies, which result in surface waters contaminated with high zinc levels and low pH.

F. Washoff from a wood by-products company of oil, grease and organics high in BOD have polluted the Q Street drainage channel and caused a fish kill in Alton Baker Pond in 1972.

G. Storm drainage runoff from industrial and railroad land near South A Street and 2nd Street in Springfield have polluted the Springfield Millrace with high concentrations of metals, oils, grease and coliforms, resulting in the closure of Island Park to swimming.

III. ADMINISTRATION

A. Site Maintenance Plan

A site maintenance plan is required for industrial sites within the City of __________. The site maintenance plan shall address the following:

1. Information relating to topography, soils, hydrologic features, existing drainage systems, existing vegetation cover and location of the lot(s) in the major watershed.
2. Amount and location of existing impermeable areas and areas impermeable after development.
3. Proposed measures for storm management which must address the development and maintenance of structures, devices and landscaping necessary to limit the increase surface runoff of storm water and prevent associated pollutants from exceeding the standards set forth in Section III-B of this ordinance.
4. A list of potentially hazardous materials.
5. A spill control handling plan which addresses emergency procedures for handling spills of hazardous and noxious materials identified through the review of the list of potentially hazardous materials.
6. Proposed measures for the prevention of tracking mud, dirt and debris from the site during construction and operation of the industrial facility.
7. A drainage plan for sites larger than one-half acre.

The plan shall be kept available on file with the City of __________.

B. Standards

It is illegal for any industry to allow the discharge of any of the following materials or the development of the following conditions, either directly from the industrial site or through surface runoff, to occur to adjacent properties or water courses:

1. A biochemical oxygen demand (BOD^7) of more than 50 mg/l or a chemical oxygen demand (COD) of more than 75 mg/l.
2. A suspended solids content of more than 50 mg/l.
3. Liquids, which at the point of discharge onto adjacent properties or water courses, contain the following toxic substances, at levels exceeding the associated maximum concentrations:

a.	arsenic	0.20 mg/l
b.	cadmium	0.05 mg/l
c.	chromium	0.20 mg/l
d.	copper	0.20 mg/l
e.	cyanide	0.20 mg/l
f.	mercury	0.05 mg/l
g.	lead	0.20 mg/l
h.	nickel	0.50 mg/l
i.	phenols or cresols	0.50 mg/l
j.	zinc	0.50 mg/l
k.	total nitrogen	5.00 mg/l
l.	total phosphorus	1.00 mg/l
m.	formaldehyde and urea	10.00 mg/l

6. Any wastewater having a pH lower than 5.5 or higher than 9.0

7. Any radioactive material

8. Any gasoline, benzene, naptha, cleaning solvents, oil- and water-based paints, grease, alcohol, fuel, oil, mineral oil or other flammable or explosive liquid, solid or gas, in concentrations of 20.0 mg/l or greater, except in an emergency when directed by the City Engineer, the Chief of the Fire Department or the Chief of Police.

9. Discharges having a temperature of 40°C or greater

10. Pesticides having greater concentrations than the instream limits approved by the Environmental Protection Agency

11. Any floatable materials which may create health hazards or drainage obstructions

12. Any substance directly resulting in the immediate destruction of fish or other aquatic plants or animals.

C. Information Available

The City of ________________ will make available to industrial site owners, operators and managers information and data concerning appropriate techniques for erosion prevention and runoff and spill control (Best Management Practices).

IV. REVIEW, APPROVAL AND APPEAL

A. Review

The site maintenance plan shall be reviewed by a design team composed of the Planning Director, the City Engineer and any other necessary City staff.

B. Bonding

As a condition of approval of the site maintenance plan, performance guarantees and maintenance bonds, not to exceed one percent of the true cash value of the proposed development, may be required by the Planning Director to ensure the proper development of proposed structures and devices for storm water management and pollution control.

C. Appeal

Appeals to decision of the Planning Director may be made, in writing, to the Planning Commission, within ten (10) days from the date of each decision.

V. ENFORCEMENT

A. Inspection

The City shall retain the right to enter the industrial site premises, after giving reasonable notice, to inspect the construction, operation and maintenance of all storm water management and pollution control structures. The City shall retain the right, at all times, to enter the industrial site premises to inspect or rectify an emergency situation where hazardous or noxious materials have been spilled or where waste water which exceeds the standards of Section III-B have been detected on adjacent properties or waterways.

B. Standard Methods

The sampling and analysis of those materials described in Section III-B, shall be conducted by City public works personnel, through the procedures set forth in the most recent edition of "Standard Methods for the Examination of Water, Sewage and Industrial Wastes," published jointly by the American Public Health Association, the American Water Works Association, and the Federation of Sewage and Industrial Wastes Associations or by other comparable procedures as may be approved by the Environmental Protection Agency.

C. Penalties

Industries violating the standards of Section III-B of this ordinance shall be subject to a fine levied by properly authorized personnel of the Public Works Department of the City. A violation of this ordinance shall be considered a separate offense for each day the violation continues. Each violation shall be subject to a fine not to exceed $500.00, plus the cost of laboratory analysis of samples exceeding the standards of Section III-B of this ordinance. Fines imposed shall be placed in a special fund to be used in the enforcement of this ordinance and to provide low interest loans to local industries for the development of devices and structures to prevent, reduce or control storm runoff and spill pollution.

URBAN STORMWATER RUNOFF FINANCIAL MANAGEMENT PROGRAM FOR THE EUGENE/SPRINGFIELD METROPOLITAN AREA

METROPOLITAN AREA SUMMARY

LANE COUNCIL OF GOVERNMENTS
North Plaza Level PSB
125 Eighth Avenue East
Eugene, Oregon 97401

SEPTEMBER, 1981

REGISTERED PROFESSIONAL ENGINEER
9627
Richard E Warren
OREGON
DEC. 2, 1977
RICHARD E. WARREN

KRAMER, CHIN & MAYO, INC.
10 SW Ash Street
Portland, Oregon 97204

DAVID M. DORNBUSCH & COMPANY, INC.
71 SW Oak Street
Portland, Oregon 97204

CHAPTER 1
EXECUTIVE SUMMARY

1.1 BACKGROUND AND PURPOSE

The National Urban Runoff Program (NURP), directed by the U.S. Environmental Protection Agency (EPA), is a concentrated national program to study means of reducing water pollution related to stormwater runoff from urban areas. As part of this program, the Lane Council of Governments was selected by EPA to conduct a study of methods to finance drainage management to ensure water quality in two Oregon communities: Eugene and Springfield.

Eugene, Oregon's second largest city, has a (1980) population of approximately 105,000 in an area of over 20,000 acres. The city's population is projected to grow to 160,000 by the year 2000. Springfield's population is approximately 41,000 (1980) and covers approximately 9,000 acres. Population is forecasted to grow to 66,000 by the year 2000.

The objectives of the study were:

1) To evaluate the existing drainage management and financing methods and develop improvement options (including a financial plan for a program to enhance water quality).

2) To develop an interactive process with staff and elected officials of each city so they might better understand current drainage management practices as well as options for funding those operations, capital needs, and an enhanced program to improve runoff water quality.

3) To recommend a funding program for management of urban stormwater runoff quantity and quality and define a pathway for implementing that program.

4) To generalize the results of the Eugene/Springfield study for the benefit of the NURP and other communities.

1.2 MAJOR FINDINGS

1.2.1 Water Quality

Urban runoff has caused significant water quality degradation in the Eugene/Springfield area. Pollution from urban runoff hampers use of waterbodies, detracts from the aesthetic appeal and safety of streams and ponds, and endangers natural aquatic life. Correction of these problems has been hampered by limited funds for maintenance of the drainage system and enforcement of water quality ordinances.

1.2.2 Interaction of Stormwater Runoff Quantity and Quality

Municipal responsibility for management of stormwater quantity is well understood, whereas management for stormwater quality is relatively new and less well accepted. Improving management and financing methods for stormwater quantity is a necessary prerequisite to implementing programs to improve the water quality of local streams and water bodies.

1.2.3 Organization

Although the current organizational and management arrangements for drainage management have worked, there is no central responsibility for drainage management in either city. Responsibility for different aspects of drainage is divided amongst different divisions within public works (maintenance, building, engineering, and administrative divisions).

1.2.4 Expenditures

Present expenditures (1981-1982) for administration, operation, and maintenance of the drainage system are $1.3 million per year in Eugene and $560,000 per year in Springfield. The per capita expenditures are roughly the same for both cities: $1.03 per month in Eugene; and $1.14 per month in Springfield.

1.2.5 Projected Capital Needs

Long-term capital needs differ greatly in the two cities. Eugene's projected capital needs for a trunk drainage system, to be constructed by the City over the next 20 years, are expected to be about $10 million. Springfield's system will cost $38 million.

1.2.6 Drainage Management Needs

To reduce pollution from urban runoff an on-going drainage management program is needed, including regular maintenance of the drainage system and streets, enforcement of drainage related ordinances and a public information program. Many of these functions are currently performed by the Public Works Department but many others have been overlooked due to inadequate funding.

1.2.7 Water Quality Improvement Program

A program to improve protection of water quality in Eugene and Springfield was defined. It would add $1,274,000 per year to drainage management costs in Eugene and $441,000 per year in Springfield. The program includes the items in Table 1.1 ranked according to cost effectiveness. Depending on funding availability, any or all of these functions can be implemented.

TABLE 1.1

WATER QUALITY ENHANCEMENT PROGRAM

NAME	DESCRIPTION
1. Monitoring	Regular monitoring of water quality parameters in runoff.
2. Spill Prevention/Response	Install traps for hazardous material spills and develop a plan for response to spills.
3. Public Information Program	Program to inform public on drainage and runoff problems.
4. Industrial/Commercial Site Management	Require management of commercial and industrial lots to protect water quality.
5. Capital Improvement Planning	Prepare capital improvement plans including water quality concerns.
6. Storm Sewer Maintenance Program	Increased inspection, repair, cleaning, and mapping of storm sewers.
7. Detention/Retention Basins	Install basins to act as trash and sediment traps at key spots.
8. Storm Sewer Catch Basins	Clean catch basins on a schedule dependent on traffic load.
9. Street Sanitation	Adjust and expand street sweeping schedule to maximize water quality protection.
10. Development and Construction Controls and Monitoring	Implement procedures to explain and encourage practices to protect water quality during construction.
11. Street Maintenance	Pave gravel streets and repair broken pavement.
12. Channel and Vegetation Maintenance	Maintain drainage channels to protect water quality; in particular, harvest vegetation regularly.

1.3 RECOMMENDATIONS

It is recommended that the Cities of Eugene and Springfield manage drainage as a utility within their public works departments. Several organization schemes are possible but all share the critical feature that a single person or division be responsible for coordinating all drainage management functions.

For both Eugene and Springfield, it is recommended that their financing arrangements for drainage management be changed to a method based on a drainage utility service charge. This charge would be based on the amount of stormwater runoff from each property. The rate would be calculated on the amount of impervious surface on each property such as buildings, driveways and parking areas. Average rates could be established for classes of property with similar characteristics such as single family properties. Rates for a single family property would depend on the drainage management costs funded from the service charge, and could range from $1.50 per month per household to fund current practices, to as high as $5.00 per month per household if all capital needs and the full water quality enhancement program are funded.

One advantage to a drainage utility service charge is that it directly relates charges to the benefits provided. Such a system of charges would also provide an assured revenue source which would increase as additional properties in the cities are developed or new areas are annexed.

It is recommended the Cities of Eugene and Springfield adopt the water quality enhancement program outlined in this report.

1.4 APPLICABILITY TO OTHER COMMUNITIES

The drainage utility approach recommended for Eugene and Springfield is applicable to other communities facing problems of financing drainage management or interested in improving water quality and requiring additional revenue sources to support such improvements. The utility service charge has a number of advantages:

The utility service charge is equitable and fair in that it relates the amount of stormwater generated by a property to the drainage management costs assessed to the property.

A drainage utility service charge can be tailored to local sensitivities and needs. The service charge can be used to fund management of drainage water quantity or quality, improvement of drainage system aesthetics (channel cleaning and street sweeping), or construction of new drainage structures. Rates can be set to provide incentives for citizens to reduce runoff quantities or improve runoff water quality. Rates can be set higher for special property types which potentially generate high pollutant loadings or lower to encourage practices to reduce runoff pollution.

A service charge is relatively easy to administer. Although it does require a separate billing for each property, average runoff amounts can be calculated for classes of property. Specific calculations may be necessary for unusual properties and an appeals process should be established for property owners who wish to review the assessment methods. Billing can be accomplished by adding a line item to existing utility bills for water or sewage.

A drainage utility service charge provides a stable revenue source independent of other governmental service needs which is devoted specifically to drainage management, something very much needed for on-going maintenance and protection of water quality. Revenues will increase as new properties are developed or added to the City.

The service charge and its fairness in assigning costs based upon the amount of stormwater generated or the potential pollutant load can be readily understood by the public.

Properties that may not otherwise pay for drainage management services because of property tax exemption (e.g. churches, schools, state and federal properties) can be charged a service fee for drainage. This distributes the drainage costs more equitably to all properties.

CITY OF EUGENE, OREGON

URBAN STORMWATER RUNOFF FINANCIAL MANAGEMENT PROGRAM

LANE COUNCIL OF GOVERNMENTS
North Plaza Level PSB
125 Eighth Avenue East
Eugene, Oregon 97401

SEPTEMBER, 1981

9627
Richard E Warren
DEC. 2, 1977
RICHARD E WARREN

KRAMER, CHIN & MAYO, INC.
10 SW Ash Street
Portland, Oregon 97204

DAVID M. DORNBUSCH & COMPANY, INC.
71 SW Oak Street
Portland, Oregon 97204

CHAPTER 1
EXECUTIVE SUMMARY

1.1 BACKGROUND

The City of Eugene, over the years, has evolved a system of managing stormwater runoff. This system has worked well in the past; however, changing conditions make it necessary to review the present situation and to plan for the most effective method of stormwater management. One change is the increasing interest in protecting water quality in the streams and water bodies of the community; another is the increasing difficulty of providing adequate financial resources for managing stormwater runoff because of the tightening budget constraints on the City of Eugene. Urban growth has increased peak runoff rates into the drainage system, much of which is old and in need of repair.

In order to get a better look at these problems, the City of Eugene, together with Springfield, has been participating in development of an Urban Stormwater Runoff Financial Management Program, a study supported by the U.S. Environmental Protection Agency and managed by the Lane Council of Governments. The study basically sought to answer three questions:

1) How is stormwater drainage currently managed, and how is it currently financed?

2) What improvements for stormwater runoff management and financing are appropriate?

3) How can measures to improve stormwater runoff water quality be financed?

1.2 FINDINGS

1.2.1 Water Quality

Urban runoff has caused significant water quality degradation in the Eugene area. Pollution from urban runoff hampers use of waterbodies, detracts from the aesthetic appeal and safety of streams and ponds, and endangers natural aquatic life. Correction of these problems has been hampered by limited funds for maintenance of the drainage system and enforcement of water quality ordinances.

1.2.2 Interaction of Quantity and Quality

Municipal responsibility for management of stormwater quantity is well understood, whereas management for stormwater quality is relatively new and less accepted. Improving management and financing methods for stormwater quantity is a necessary prerequisite to implementing programs to improve the water quality of local streams and water bodies.

1.2.3 Drainage System

Eugene's stormwater drainage system consists of 33 miles of major open drainage channels; 130 miles of minor ditches, and 120 miles of piped storm sewers with more than 7,000 catch basins and curb inlets. Stormwater runoff from the system is discharged into the Willamette River or to Fern Ridge Reservoir.

1.2.4 Organization

Responsibility for drainage management is mainly in the Public Works Department, although the Planning Department and Parks and Recreation are also important in aspects of drainage management. Within Public Works, the Maintenance Division is responsible for maintenance of the system (street sweeping, cleaning catch basins, pipes, channels, and ditches, etc.); the Building Division checks plans, and issues and enforces permits particularly during construction; the Engineering Division plans and designs storm sewers, channels and ditches.

The Planning Department, through its land use regulation authority, affects drainage management by influencing the arrangement of land uses and the timing of development. The Parks and Recreation Department affects drainage because many streams flow through city parks where the management of those streams can affect both water quantity and quality. There is no central responsibility for coordination of drainage management in Eugene.

1.2.5 Expenditures

Projected operations and maintenance expenditures for drainage management in Eugene in 1981-82 are $1,334,000. Projected capital costs for the City are estimated at $4.4 million for 1981-1985; $4.2 million in 1985, and $1,000 million for 1990-2000. The largest single source of revenue for operation and maintenance has been the sewer utility fund, which is derived largely from sewer user charges covering both sanitary and storm sewers. The second largest source accounting for 34 percent of all drainage management funds in fiscal year 1979-80 was the City's General Fund. Other minor sources include bond sales, systems development charges, special districts (e.g., downtown development district), and federal programs. Capital improvements have been largely paid for by bonds which are repaid from property tax revenues.

Recently Eugene established a Systems Development Charge which requires new developments to pay the estimated cost of expanding City streets, sewers, water and storm drains to serve new development. Payments are based on the building permit value and the impervious area of the new development.

1.2.6 Ordinances and Regulations

Eugene's current ordinances and regulations are generally adequate for drainage management. However, incentives to promote on-site detention and reinfiltration (i.e., reducing runoff at its source) could strengthen the development ordinances. For commercial and industrial areas stormwater runoff regulations are vague with no clear enforcement procedures or penalty schedules. More specific ordinances and improved enforcement procedures would facilitate enforcement.

1.2.7 Drainage Management Needs

To reduce pollution from urban runoff, an ongoing drainage management program is needed including a wide variety of practices such as regular maintenance of the drainage system and streets, enforcement of drainage related ordinances and a public information program. Many of these functions are currently performed by the Public Works Department but many others have been overlooked due to inadequate funding.

1.2.8 Water Quality Improvement Program

An enhancement program to improve drainage management in terms of protection of water quality would increase Eugene's annual operation and maintenance expenditures by $1.3 million, i.e., would approximately double current expenditures. The water quality enhancement program considered for Eugene includes the items in Table 1.1 ranked according to relative cost effectiveness.

Implementation of these programs would cost up to $1.56 per household in Eugene. Depending on funding available any or all of these drainage management functions can be added.

TABLE 1.1

WATER QUALITY ENHANCEMENT PROGRAM

NAME	DESCRIPTION
1. Monitoring	Regular monitoring of water quality parameters in runoff.
2. Spill Prevention/Response	Install traps for hazardous material spills and develop a plan for response to spills.
3. Public Information Program	Program to inform public on drainage and runoff problems.
4. Industrial/Commercial Site Management	Require management of commercial and industrial lots to protect water quality.
5. Capital Improvement Planning	Prepare capital improvement plans including water quality concerns.
6. Storm Sewer Maintenance Program	Increased inspection, repair, cleaning, and mapping of storm sewers.
7. Detention/Retention Basins	Install basins to act as trash and sediment traps at key spots.
8. Storm Sewer Catch Basins	Clean catch basins on a schedule dependent on traffic load.
9. Street Sanitation	Adjust and expand street sweeping schedule to maximize water quality protection.
10. Development and Construction Controls and Monitoring	Implement procedures to explain and encourage practices to protect water quality during construction.
11. Street Maintenance	Pave gravel streets and repair broken pavement.
12. Channel and Vegetation Maintenance	Maintain drainage channels to protect water quality; in particular, harvest vegetation regularly.

1.3 RECOMMENDATIONS

We recommend that Eugene change its financing arrangements for drainage management to a drainage utility service charge based upon the amount of stormwater runoff from each property. A service charge of $1.70 per month per household would fund the existing drainage management program. A service charge of $3.40 per month per household would fund the existing program plus the total water quality enhancement program and the expected capital needs for the next five years. This drainage utility charge would replace the sewer user charge and the General Fund as revenue sources. The Systems Development Charge, which already is in part based on the amount of stormwater runoff, should remain. Similarly, the building permit fee should remain.

The advantage of a drainage utility service charge is that it directly relates the benefit received (i.e. taking care of the stormwater runoff) to the charge. The service charge is equitable because it takes into account variations in the amount of runoff generated from a property. Tax exempt properties are also required to pay the charge just as they now pay for sanitary sewer and water service. Such a source of revenue would relieve demand on the General Fund and provide a certainty of funding level for drainage management in the future. Drainage management revenues would also increase automatically as property is developed or new areas are added to the service area. The drainage utility charge could be added as a line item to the present sewer bill.

A drainage utility service charge can be structured to meet a wide variety of needs. Rates can be set to provide incentives for installation of runoff control and adoption of best management practices to protect water quality.

We recommend that the City designate a drainage management coordinator within the Department of Public Works to bring together the functions for drainage management. Departments and divisions would continue to carry out their existing responsibilities for drainage management, but the coordinator would have the function of providing overall direction and policy coordination for drainage management. Eugene may in the future wish to consider reorganizing drainage managment as a drainage utility. The requirements and procedures for such a utility are provided in Chapter 6.

We recommend that Eugene develop stormwater runoff regulations specifically for commercial and industrial uses which clearly describe runoff requirements, specify penalties, and describe enforcement procedures. A procedure to permit staff to write "tickets" for violations could facilitate enforcement if the City is willing to give staff the necessary authority. The City should also consider amending its development ordinances to provide incentives to reduce runoff and improve water quality such as density bonuses for on-site detention or reinfiltration of stormwater.

We recommend that Eugene adopt at least a major portion of the water quality enhancement program outlined in this report. This would be a cost effective means to improve local water quality.

1.4 CONCLUSION

Implementation of these recommendations would provide an assured and constant source of revenue for drainage management for Eugene that is generally equitable to property owners. Designation of a coordinator would be a first step to assuring overall coordination and policy direction to drainage management concerns for both quantity and quality. Revision of the ordinances would help strengthen enforcement in commercial and retail areas and provide incentives for water quality protective design features built into new residential developments. Implementation of all or a portion of the water quality enhancement program would immediately improve runoff water quality at an affordable cost. Such steps would put Eugene in the forefront of communities taking positive steps to better handle stormwater runoff.

CITY OF SPRINGFIELD, OREGON

URBAN STORMWATER RUNOFF FINANCIAL MANAGEMENT PROGRAM

LANE COUNCIL OF GOVERNMENTS
North Plaza Level PSB
125 Eighth Avenue East
Eugene, Oregon 97401

SEPTEMBER, 1981

REGISTERED PROFESSIONAL ENGINEER
9527
DEC. 2, 1977
RICHARD E. WARREN

KRAMER, CHIN & MAYO, INC.
10 SW Ash Street
Portland, Oregon 97204

DAVID M. DORNBUSCH & COMPANY, INC.
71 SW Oak Street
Portland, Oregon 97204

CHAPTER 1
EXECUTIVE SUMMARY

1.1 BACKGROUND

The City of Springfield has evolved a system of managing stormwater runoff over the years that has worked reasonably well. However, changing conditions make it necessary to review the present situation and to plan for the most effective method of stormwater management. One change is the increasing interest in protecting water quality in the streams and water bodies of the community; another is the increasing difficulty of providing adequate financial resources for managing stormwater runoff because of the tightening budget constraints on the City of Springfield. Urban growth has increased peak runoff rates into a drainage system, much of which is old and in need of repair.

In order to get a better look at these problems, the City of Springfield, together with Eugene, participated in development of an Urban Stormwater Runoff Financial Management Program, a study supported by the U.S. Environmental Protection Agency and managed by the Lane Council of Governments. The study basically sought to answer three questions:

1) How is stormwater drainage currently managed, and how is it currently funded?

2) What improvements for stormwater runoff management and financing are appropriate?

3) How can measures to improve stormwater runoff water quality be financed?

1.2 FINDINGS

1.2.1 Urban runoff has caused significant water quality degradation in the Springfield area. Pollution from urban runoff hampers use of water bodies, detracts from the aesthetic appeal and safety of streams and ponds, and endangers natural aquatic life. Correction of these problems has been hampered by limited funds for maintenance of the drainage system and enforcement of water quality ordinances.

1.2.2 Municipal responsibility for management of stormwater quantity is well understood, whereas management for stormwater quality is relatively new and less well accepted. Improving Springfield's management and financing methods for stormwater quantity is a necessary prerequisite to implementing programs to improve the water quality to local streams and water bodies.

1.2.3 Springfield's stormwater drainage system consists of 18 miles of major open drainage channels; 75 miles of roadside ditches; and 100 miles of piped storm drains and 3,900 catch basins. There have been only isolated storm drain problems in the central and western parts of the City. The eastern part of Springfield has inadequate storm drainage due to rapid residential growth.

1.2.4 Responsibility for drainage management is mainly in the Department of Public Works, although the Planning Department also plays a role in aspects of drainage management. Within Public Works, the Maintenance Engineering, Building, and Environmental Affairs Divisions are all involved in drainage management. The Planning Department through its land use regulation authority affects drainage management by influencing the arrangements of land uses and the timing of development. There is no central responsibility for drainage management in Springfield.

1.2.5 Springfield's current ordinances and regulations are generally adequate for drainage management with the exception of authority to control pollution from commercial and industrial sites. Springfield has recently revised its development ordinances (Chapter X) to include provisions for hillside development and site grading, excavating and earthwork.

For commercial and industrial areas, stormwater runoff regulations are vague with no clear enforcement procedures or penalty schedules. More specific ordinances and improved enforcement procedures would facilitate enforcement.

1.2.6 Expenditures for drainage management in Springfield in FY 1979-1980 were $449,050; the budgeted amounts for FY 1980-1981 and 1981-1982 were $692,950 and $1,961,000 respectively. Projected capital costs for drainage management are estimated at $6.2 million for 1981-1985; $7.4 million for 1986-1990; and $24 million for 1991-2000.

The largest single funding source for storm drainage is the General Fund which provided 60 percent of the revenues in FY 1980-1981. The General Fund has many other competing needs and, therefore, is an uncertain source for future drainage management funding. The General Fund is not particularly equitable for drainage management because revenues are based on value of a property rather than contribution of property to runoff. The second large source accounting for 15 percent in 1980-1981 was federal revenue sharing. This source too is uncertain because of changing federal priorities and funding availability.

1.2.7 To reduce pollution from urban runoff, an on-going drainage management program is needed including a wide variety of practices such as regular maintenance of the drainage system and streets, enforcement of drainage related ordinances, and a public information program. Many of these functions are currently performed by the Public Works Department, but many others must be overlooked due to inadequate funding.

1.2.8 An enhancement program to improve protection of water quality would increase Springfield's annual operation and maintenance expenditures by $440,000; i.e., would approximately double current expenditures. The water quality enhancement program considered for Springfield includes the items in Table 1.1 ranked according to relative cost effectiveness.

Implementation of these programs would cost up to $1.47 per house in Springfield. Depending on funding available, any or all of these drainage management functions can be added.

1.3 RECOMMENDATIONS

1.3.1 We recommend that Springfield shift its financing arrangements for drainage management to a Drainage Utility Service Charge based upon the amount of stormwater runoff from property. The fee for an average, single-family home would be $2 to $5 per month depending on the level of service selected. A service charge of $2 per month would fund the existing drainage management program with no additional capital or maintenance funding. A service charge of $5 per month would fund the full water quality enhancement program and capital needs for the next five years. This drainage utility charge would replace the principal current revenue source, the General Fund. The systems development charge, which assesses new developments for capital improvements required to service the new developments, should remain. Similarly, the building permit fee, a minor source of revenue, should remain in place.

The advantage of a drainage utility service charge is that it directly relates the benefit received (i.e., taking care of the stormwater runoff) to the charge. The service charge is equitable because it takes into account variations in the amount of runoff generated from a property. Tax exempt properties are also required to pay the charge just as they now pay for sanitary sewer and water service.

TABLE 1.1

WATER QUALITY ENHANCEMENT PROGRAM

NAME	DESCRIPTION
1. Spill Prevention/Response	Install traps for hazardous material spills and develop a plan for response to spills.
2. Public Information Program	Program to inform public on drainage and runoff problems.
3. Industrial/Commercial Site Management	Require management of commercial and industrial lots to protect water quality.
4. Monitoring	Regular monitoring of water quality parameters in runoff.
5. Detention/Retention Basins	Install basins to act as trash and sediment traps at key spots.
6. Development and Construction Controls and Monitoring	Implement procedures to explain and encourage practices to protect water quality during construction.
7. Storm Sewer Maintenance Program	Increased inspection, repair, cleaning, and mapping of storm sewers.
8. Street Sanitation	Adjust and expand street sweeping schedule to maximize water quality protection.
9. Street Maintenance	Pave gravel streets and repair broken pavement.
10. Storm Sewer Catch Basins	Clean catch basins on a schedule dependent on traffic load.
11. Channel and Vegetation Maintenance	Maintain drainage channels to protect water quality; in particular, harvest vegetation regularly.
12. Capital Improvement Planning	Prepare capital improvement plans including water quality concerns.

Such a source of revenue would reduce the demand on the General Fund and provide a certainty of funding level for drainage management in the future. Drainage management revenues would also increase automatically as property is developed or new areas are added to the service area. The drainage utility service charge could be added as a line item to the present sewer bill.

A drainage utility service charge can be structured to meet a wide variety of needs. Rates can be set to provide incentives for installation of runoff control, and adoption of the best management practices to protect water quality.

1.3.2 We recommend that a drainage management coordinator be designated within the Department of Public Works to bring together the functions of drainage management. Departments and Divisions would continue to carry out their existing responsibilities for drainage management, but the coordinator would have the function of providing overall direction and policy coordination for drainage management. Springfield may wish to consider reorganizing drainage management as a drainage utility at some later time.

1.3.3 We recommend that Springfield develop stormwater runoff regulations specifically for commercial and industrial uses which clearly describe runoff requirements, specify penalties, and describe enforcement procedures. A procedures to permit staff to write "tickets" for violations could facilitate enforcement if the City is willing to give staff the necessary authority.

1.3.4 We recommend that Springfield adopt at least a major portion of the water quality enhancement program outlined in this report. This would be a cost effective means to improve local water quality.

1.4 CONCLUSION

Implementation of these recommendations would provide an assured and constant source of revenue for drainage management in Springfield that is generally equitable to property owners. Designation of a coordinator would be a first step to assuring overall coordination and policy direction to drainage management concerns for both quantity and quality. Revision of the ordinances would strengthen enforcement in commercial and retail areas. Implementation of all or a portion of the water quality enhancement program would improve runoff water quality at an affordable cost. Such steps would put Springfield in the forefront of communities which are taking positive steps to better handle stormwater runoff.

DATE November 9, 1981
TO Mayor and City Council
FROM Steven C. Burkett, City Manager
SUBJECT PROPOSED STORM DRAINAGE USER FEES

NOV 10 1981

COVER TRANSMITTAL MEMO

SPRINGFIELD

This memorandum is written to provide you with background information for the November 16, 1981 public hearing on proposed storm drainage user fees.

PROBLEM

At a February 1981 Work Session, the Council reviewed a draft report by the consulting firm of Kramer, Chin and Mayo, Inc. (KCM) regarding proposed storm drainage user fees. After discussion, the Council approved the concept of storm drainage user fees and authorized staff to continue developing a proposal. During the development and adoption of the City's 1981-82 Annual Budget, the Budget Committee and Council approved reducing the General Fund tax levy by $195,000 in anticipation of an equal amount of revenue from a storm drainage user fee.

DISCUSSION

At the September 21, 1981 Council meeting, you received the final report prepared by KCM, entitled "Urban Stormwater Runoff Financial Management Program for the City of Springfield." This report was prepared for the City through the National Urban Runoff Program, a Federal grant program in which the City is participating through the Lane Council of Governments. (KCM prepared a similar report for the City of Eugene.)

The study addresses ways to improve stormwater quality and ways to finance drainage services. The consultants' recommendations are, basically, to

(1) shift financing of drainage activities from the property tax to a user fee, and
(2) adopt certain additional drainage services in order to improve stormwater quality.

At your October 26, 1981 Work Session, you heard and discussed staff's proposal, which is attached as Charts #1, #2, #3 and #4 dated 10/27/81. After your discussion, you called for a November 16, 1981 public hearing on this matter and directed staff to draft a proposed ordinance, which is also attached.

RECOMMENDATION

Adoption of staff's proposal to assess a drainage user fee beginning January 1, 1982 at the basic rate of $1.75 per Equivalent Residential Unit (ERU).

ACTION REQUIRED

Conduct a public hearing, discuss this matter, review the proposed ordinance, and provide direction to City staff. Adoption of the ordinance, if deemed appropriate by the Council, is scheduled for December 7, 1981.

Steven C Burkett
Steven C. Burkett
City Manager

SCB/DEB:sk

Attachments

CHART #1
10/27/81

REVENUE REQUIREMENTS
(1981-82 FISCAL YEAR)

CURRENT SERVICES

	COST
Maintain 100 miles of pipe, 3400 manholes and 3900 catch basins (Subsurface Drainage)	$ 89,000
Maintain 75 miles of roadside ditches and 18 miles of cross-country ditches (Surface Drainage)	49,500
Weed and Brush Control	23,500
Sweep and Flush Streets (Improved Street Maintenance)	40,500
Unimproved Street Maintenance	5,500
Plan Review Activities	4,000
Building Code Enforcement (Plumbing and Mechanical Safety)	22,000
Zoning Code Enforcement	7,000
City Code Enforcement	9,500
Maintain Vehicles and Equipment	11,000
Maintain Buildings	9,500
Billing	8,000
Subtotal	$279,000
Administration (18.6%)	51.900
Total	$330,900

ENHANCEMENT SERVICE

Spill Prevention	$ 21,000
Public Information	8,000
Industrial/Commercial Site Management	28,000
Monitoring	9,000
Detention/Retention	2,000
Development and Construction Controls and Monitoring	34,000
Subtotal	$102,000
Administration (18.6%)	19,000
Total	$121,000
GRAND TOTAL	$451,900
TOTAL REVENUE REQUIREMENTS	$451,900

ERU FEE DERIVATION

Average single family home and lot contains 2500 square feet of impervious surface.

If each single family dwelling is assigned 1 Equivalent Residential Unit (ERU), the number of ERU's for each non-single family property can be computed by dividing the impervious surface of the property by 2500 square feet.

LAND USE	ESTIMATED NUMBER OF UNITS	ESTIMATED ERU/UNIT	NUMBER OF ERU'S
Single-family, duplex living units and mobile homes on own lot	11,300	1	11,300
Apartment living units and mobile homes in courts	5,300	1	5,300
Commercial properties	800	10	8,000
Industrial properties	13	15	195
		TOTAL	24,795
		ROUNDED TOTAL (ESTIMATED)	25,000

REVENUE REQUIREMENTS = $451,900/YEAR = $37,700/MONTH

$\frac{37{,}700 \text{ Per Month}}{25{,}000 \text{ ERU's}}$ = $1.51 per month per ERU for remainder of 1981-82 Fiscal Year.

LENGTH OF PROPOSED PROGRAM	REQUIRED FEE PER MONTH PER ERU (10% INFLATION)
1 YEAR	$1.70
2 YEARS	1.75
3 YEARS	1.85
4 YEARS	1.95
5 YEARS	2.05

CHART #3
10/27/81

OTHER CONSIDERATIONS

ISSUE	RECOMMENDATION
Minimum Fee	$1.75 per property ERU for residential, multiple-family, residential-professional mobile home park and mobile home subdivision. $1.75 per account ERU for commercial and industrial. $0.90 per account ERU for commercial and industrial properties that drain to County system, river, etc.
Billing	Drainage fee will be charged to account receiving sanitary sewer billing. Hand billing for those new accounts with no electric, sewer or water billing.
ERU Determination	0 - 2500 s.f. = 1 ERU 2501 - 5000 s.f. = 2 ERU's 5001 - 7500 s.f. = 3 ERU's, Etc.
Vacant Lots	No fee as long as unimproved.
Semi-pervious Material	Property ERU will be reduced by relative runoff coefficients.
Private Drainage System (Retention/Detention)	Fee, if any, to be based on discharge rate to City (public) system.

CHART #4
10/27/81

IMPLEMENTATION SCHEDULE

ACTIVITY	DATE
Council Work Session to discuss drainage program	October 26, 1981
Begin field and office work to review 500 multiple family accounts, 900 commercial accounts and 3000 special non-sewer accounts. Additionally, office review 6500 accounts that are billed to another party. Coordinate with S.U.B. and Rainbow Water District.	November 1, 1981
Public hearing and proposed Ordinance	November 16, 1981
Council adoption of Ordinance	December 7, 1981
Establish actual billings for most properties and provide billings to S.U.B.	December 8, 1981
S.U.B. mails first bills	February, 1982
First revenue received	Early April, 1982

DATE November 6, 1981
TO Mayor and City Council
FROM Michael A. Kelly, Director of Public Works
SUBJECT STORM DRAINAGE USER FEE

COVER TRANSMITTAL MEMO

SPRINGFIELD

This memorandum is written to provide clarification to concerns expressed by Council members at the October 26, 1981 Work Session.

(1) CONCERN: *Will converting incurred drainage costs to a utility basis reduce the tax levy?*

For the 1981-82 fiscal year, $195,000 of drainage utility revenue was assumed to be received by July 1, 1982. In effect, this offset the need for $195,000 of General Funds (tax revenue). If the Budget Committee and City Council do not substitute other expenditures for this reduced tax burden, converting to a utility base will reduce future tax requirements.

(2) CONCERN: *There appears to be no immediate need to implement the drainage utility program. Why not delay action until all development fees in Springfield can be reviewed?*

Because the current 1981-82 fiscal year budget assumes $195,000 of drainage utility revenue, it is important that this program be implemented as soon as possible. Even under the most optimistic implementation schedule, only $130,000-150,000 of funds will be received this fiscal year, resulting in a deficit of over $50,000. For every month of delay, approximately $44,000 of revenue is lost.

CONCERN: *The money for the drainage utility shouldn't be collected from residents living on unimproved streets as there are no storm sewers. The money shouldn't be collected from residents living on improved streets as they or the developer paid for the storm sewers initially.*

The revenue from the proposed drainage utility is not for capital projects--past, present or future. Future storm sewer needs will be addressed during the upcoming Capital Improvements Program discussions. The revenue collected would only be used for operations and maintenance of the City's complete drainage system including:

(1) 100 miles of pipe, 3400 manholes and 3900 catch basins.
(2) 75 miles of roadside ditches and 18 miles of cross-country ditches.
(3) Flushing and sweeping of 5800 curb miles annually.
(4) Proposed water quality enhancement programs.

On a per foot basis, maintaining drainage on unimproved streets is more expensive than on improved streets.

(4) CONCERN: *Most of the rainwater soaks into the ground except in industrial and commercial areas which are more impervious. Why are we charging residential users?*

When it rains, the City must maintain the total drainage system for many millions of gallons of stormwater. This stormwater reaches the drainage system by overland flow or groundwater infiltration into ditches or pipes. Even though a dwelling may not physically be connected to a storm sewer or ditch, such system provides surface and/or groundwater relief for excess stormwater accumulation on the property. Put simply, the City's drainage system improves the ground's ability to accept rainwater.

CONCERN: *If a dwelling and/or developed property does not directly or indirectly drain to a ditch or storm sewer, why should such property be charged a drainage utility fee?*

Approximately 1/2 of the City's total surface area is impervious (roofs, patios, streets, playgrounds, sidewalk, driveways, etc.). Of the total impervious surfaces, approximately 1/2 are under public ownership such as streets, City Hall, park structures and courts, school buildings and playgrounds, public parking lots, etc. Even though a dwelling may not contribute private water to the City's drainage system, each user of the impervious public facilities has an obligation to pay a proportional cost for operations and maintenance associated with such public runoff water. While the incurred cost for treating such public water is less than the proposed $1.75 per month per dwelling, a standard minimum fee is recommended for ease of administering some 11,000 plus single-family dwelling accounts. A tremendous amount of staff time would be required to determine the number of accounts to be charged less or more than the proposed $1.75 flat fee. Even if it could be initially computed, it would require constant monthly updating.

6) **CONCERN:** *What will be the financial impact on public agencies in Springfield?*

	ERU	Monthly Fee
Springfield Utility Board	72	$ 126.00
Rainbow Water District	3	5.25
Willamalane Park District	144	252.00
School District #19	965	1,688.75
OLCC	5	8.75
McKenzie-Willamette Hospital	136	238.00
U. S. Postal Service	106	185.50
State of Oregon-Adult Services	12	21.00
Totals	1,443	$2,525.25

7) **CONCERN:** *Some Council members do not clearly understand some aspects of staff's recommended enhanced water quality services.*

During the past 5 years, stormwater runoff from urbanized areas has gained recognition as having a significant negative impact on the water quality of surface waters throughout the nation. Chapter 4 of the KCM report recommended and discussed 12 activities which could be undertaken by the City for the purpose of improving the water quality of both the natural and man-made waterways which traverse the metropolitan area. Staff has reviewed and prioritized the recommended enhancement activities and proposed inclusion of the following 6 activities as part of the overall stormwater management program:

1. Spill prevention/response
2. Industrial/commercial site management
3. Development and construction controls and monitoring
4. Detention/retention basins
5. Monitoring program
6. Public information

These 6 activities should provide the greatest water quality improvement with respect to the required investment and they will contribute to satisfying several of the goals and objectives specified in Parts III.C, III.D, and III.E of the adopted Metropolitan Area General Plan. In order to ensure the long-term effectiveness of a water quality improvement program, the recommended activities must be performed on a continuing basis. Minor portions of some of the costs identified in the report, however, are start-up or front-end costs, and will not be required annually. The following table separates the start-up from the ongoing costs of each activity.

ACTIVITY	START-UP	CONTINUING	TOTAL FIRST YR.	TOTAL SECOND YR. — ONGOING COSTS
1. Spill Prevention/Response	3,000	21,000	24,000	21,000
2. Industrial/Commercial Site	0	28,000	28,000	28,000
3. Development/Construction Controls*	4,000	30,000	34,000	34,000
4. Detention/Retention Basins	15,000	2,000	17,000	2,000
5. Monitoring Program	2,000	9,000	11,000	9,000
6. Public Information	0	8,000	8,000	8,000
TOTAL	24,000	98,000	122,000	102,000

*"Best management practices" manual cost $20,000 or $4,000/year for 5 years.

8) CONCERN: *What will be the financial impact on a typical commercial and a typical industrial account?*

COMMERCIAL

Staff's analysis of the McKenzie West shopping center revealed a total of 92 ERU's or, at $1.75/ERU, $161/month. This cost would be distributed among the shopping center tenants; the distribution ranges from 1 ERU ($1.75/month) for Taco John to 38 ERU's ($66.50/month) for Mark and Save market. Staff's analysis of Chembond's property revealed 40 ERU's or $70/month.

INDUSTRIAL

Michael A. Kelly
Director of Public Works

MAK/DEB:sk

ORDINANCE NO. ____________ (GENERAL)

AN ORDINANCE ESTABLISHING AND IMPOSING JUST AND EQUITABLE CHARGES UPON USERS OF THE CITY OF SPRINGFIELD STORM DRAINAGE SYSTEM AND REQUIRING THE SPRINGFIELD UTILITY BOARD TO COLLECT SUCH CHARGES; PROVIDING FOR COLLECTION THEREOF; ESTABLISHING A SPECIAL FUND FOR STORM DRAINAGE PURPOSES; REPEALING SECTIONS 3-4-1 AND 3-4-2; ADOPTING NEW SECTIONS 3-4-1 THROUGH 3-4-8 OF THE SPRINGFIELD CODE, 1965, AND DECLARING AN EMERGENCY.

THE CITY OF SPRINGFIELD DOES ORDAIN AS FOLLOWS:

Section 1: Sections 3-4-1 and 3-4-2 of the Springfield Code, 1965, be and are hereby repealed, and new sections numbered 3-4-1 through 3-4-8 are hereby adopted to read as follows:

"3-4-1 Storm Drainage User Charges: In order to protect water quality, reduce flooding and excess surface waters which are or may become polluted, and to improve drainage, it is necessary that there be levied and imposed upon all improved premises within the City of Springfield just and equitable charges for the use and benefit of the City of Springfield storm drainage system. Such charges shall be collected from each person, firm or corporation whose premises fall within the description of premises to be charged as hereinafter set forth in this Article.

3-4-1 Storm Drainage Charges -- DEFINITIONS: As used in this Article, the following definitions shall be applied:

(1) User -- An individual, corporation, firm, association, co-partnership, municipal subdivision or district using the City of Springfield storm drainage system.

(2) Single Family Residential Unit -- A detached building designed or used exclusively for the occupancy of one family and having housekeeping facilities for one family. Also, each half of a building designed or used exclusively for the occupancy of two families living independently of each other and having separate housekeeping facilities for each family.

(3) Equivalent Residential Unit (ERU) -- Any single family residential unit. Each ERU is presumed to place a demand on the City of Springfield storm drainage system equivalent to 2,500 square feet of impervious surfaces.

(4) Impervious Surfaces -- Those hard surface areas located upon real property which either prevent or retard penetration of water into the land surface to a greater degree than was present under natural conditions pre-existent to development, and/or which cause water to run off the land surface in greater quantities or rates of flow than which was present under natural conditions pre-existent to development. Common impervious surfaces include but are not limited to rooftops, sidewalks, walkways, patios, driveways, parking lots, and storage areas.

(5) Improved Premises -- Any area which has been altered or developed in such a way that the stormwater runoff from the site is greater either in volume, or velocity, or rates of flow, or any combination thereof, than that which could historically have been expected.

(6) Special User Unit -- Any non-residential improved premises which discharges its stormwater runoff directly to a receiving water or drainage system not under the maintenance jurisdiction of the City of Springfield.

3-4-3 Storm Drainage Charges -- Equivalent Residential Unit (ERU) Determination.

(1) Each single family residential unit as defined in this Article is furnished storm drainage service equal to that furnished to one Equivalent Residential Unit (ERU) or 2,500 square feet of impervious surface.

(2) Each property which is not a single family residential unit as defined in this Article is furnished storm drainage service in proportion to that property's impervious surface area and that, for each 2,500 square feet or portion thereof of impervious surface, said property is furnished service equal to that for one Equivalent Residential Unit (ERU). The number of ERU's determined for each property shall be whole numbers; fractions or decimal's shall not be used.

3-4-4 Storm Drainage Charges -- Rates: The following rates are hereby established and shall be charged commencing January 1, 1982.

Single Family Residential Units or ERU	$1.75 per month
All Other Residential Units	$1.75 per ERU per month
Non-Residential Units	$1.75 per ERU per month, but not less than $1.75 per month for each sanitary sewer billing account
Special User Units	$0.90 per ERU per month, but not less than $1.75 per month for each sanitary sewer billing account

The foregoing rates may be reduced for a property where approved stormwater runoff control measures have been taken; analysis shall be on a case-by-case basis as determined by the Director Of Public Works.

The charge for 15 days or less of service upon establishing or closing an account shall be one-half the applicable monthly charge.

3-4-5 Storm Drainage Charges -- Due Dates: All storm drainage charges required to be paid by the preceding section shall be payable when billed, and in the event the same are not paid in full within the current credit policies of the Springfield Utility Board, they shall be considered delinquent at that time.

3-4-6 Storm Drainage Charges -- Property Liable: Storm drainage charges called for by this Article shall be a charge against the property and, if unpaid, shall be collected from and paid by the property owner and may be certified as a lien against the property as provided in ORS 454.225.

3-4-7 Storm Drainage Charges -- Collection:

(1) The Springfield Utility Board shall be and it hereby is designated as the agent of the City to bill storm drainage charges to the user or owner for payment thereof, and payments of any and all storm drainage charges shall be made to the Springfield Utility Board at the Board's offices in the City.

(2) The Springfield Utility Board shall be responsible to the City for the collection of and accounting for only such charges as may be paid upon billing, except as hereinafter provided. The funds so received shall be remitted to the Department of Finance of the City monthly. An itemized audit shall be submitted to the

Department of Finance semi-annually within ten (10) days after the completion of the first half and the second half of the calendar year. The City shall pay to the Utility Board such sums for the service of collection as may be agreed upon by the City and the Utility Board.

(3) In the billing of such charges, the same may be billed along with charges for electric and water service, and as a part thereof. In the event of payment by a user of less than the full amount billed for all services, electric, water, sewer, and storm drainage, the amount received by the Utility Board shall be applied proportionately to storm drainage, sewer, water and electric accounts in the same proportion as the billing for each respective utility service bears to total billings, unless specifically designated in writing by the customer or user for application on electric, water, sewer or storm drainage charges specifically.

(4) To enforce collection of such charges, and as an additional remedy to all other provisions of this code, or of State statutes, the Springfield Utility Board is authorized to disconnect electric and water service or both, to any user delinquent in the payment of storm drainage user charges or fees until such delinquency charges or fees are paid and further, to charge and assess the usual charge and fee for the disconnection and reconnection upon payment.

(5) Without limiting the foregoing, the City shall have the power to and may proceed to collect delinquent charges in any other manner provided by law, including but not limited to the certification thereof to the Assessor of Lane County for collection in the

manner provided by ORS 454.225 or to file an action in Small Claims Court. In the event of collection by such means, there shall be added to the delinquent charge a penalty of 50% thereof.

(6) The Springfield Utility Board shall refuse electric and water service or both to any user and/or property owing any delinquent storm drainage user charge, as well as for delinquent electric, water and sewer charges.

3-4-9 Storm Drainage Charges -- Special Fund:

(1) The City shall maintain the funds collected and received from the Springfield Utility Board in accordance with this Article in a separate fund or program. Such funds shall be disbursed only for payment of obligations and charges incurred for and in the administration, operation, and maintenance of the City of Springfield storm drainage system.

(2) The City, upon receipt of storm drainage charges and the placing of the same in a separate fund or program as provided in this section, shall keep such accounts as will, at all times, show all receipts and disbursements from the account and the purposes to which the disbursements have been applied."

Section 2: It is hereby found and determined that matters pertaining to the storm drainage system and financial support therefore are matters affecting the health and safety of the City of Springfield, and that an emergency therefore exists. The effective date of this Ordinance shall therefore be January 1, 1982.

ADOPTED this ______ day of ____________________, 1981, by a vote of ________ for and ________ against.

APPROVED by the Mayor this ______ day of ________________ 1981.

ATTEST:

____
Mayor

____
City Recorder

APPENDIX G

PUBLIC INVOLVEMENT

CONTENTS

Mini-Workshop Schedule and Summary

Draft Public Service Announcements

Emerald Canal Background Information and Testimony

Urban Runoff Critical Areas - Background Material and Designation

March 10, 1980

TO: Interested Parties, Staff of Public Works Department

FROM: L-COG 208 Program, Gerritt Rosenthal

SUBJECT: Mini-Workshop on Urban Runoff

As part of our local effort to provide technical information on urban runoff to the Cities of Eugene and Springfield and other cities in Lane County and Western Oregon, the L-COG 208 Program is sponsoring a workshop on the problems and controls for urban runoff as related to water quality. Since runoff conditions throughout Western Oregon may be similar, the workshop may contain information that is of more than local interest, and we would invite you to attend.

As noted, the workshop is scheduled for April 3 and 4, 1980 in Eugene. We would appreciate an idea of your interest at least a week or more in advance. Please contact Gerritt Rosenthal or Becky Kreag, of L-COG's 208 Program, if you have any questions.

GR:jb

enc

142

URBAN RUNOFF MINI-WORKSHOP

Information Session for Local Managers
of
Urban Runoff and Drainage

Presented as Part of the Lane Council of Governments
208 National Urban Runoff Program
for
Local/Regional Information

PURPOSE:

To familiarize local public works managers and staffs, runoff and water quality program managers, etc., with the problems associated with urban runoff and the state of the art of control, including field considerations, best management practices, cost/benefit considerations and financing and management tools.

SESSION LENGTH AND LOCATION:

Two days -- April 3 and 4, 1980

Eugene City Council Chambers, City Hall, 777 Pearl Street, Eugene, Oregon (Eugene downtown exits from I-5 and I-105, 6th Street offramp after Ferry Street Bridge)

The workshop will begin on Thursday, at 8:30 p.m. and conclude at 4:30 p.m. on Friday. Registration will be at the door and interested persons may attend any number of sessions.

FOR FURTHER INFORMATION, CONTACT:

Lane Council of Governments, 208 Program, Gerritt Rosenthal or Becky Kreag, (503) 687-4283

FORMAT: Sessions will be informal panel presentations. Speakers will make consecutive presentations of 10-20 minutes, and the entire panel will then be prepared to respond to questions. Open dialogue and discussion is encouraged.

SESSION #1:

Thursday, April 3, 1980 -- 8:30-11:30 p.m.

Urban Runoff - What is the Problem?

A discussion of the sources of the runoff pollution, parameters, local impacts and regional concerns. Attention will be paid to local variables and situations in Western Oregon. There will be some discussion of the relationship of water quality and quantity.

Introduction

Gerritt Rosenthal, 208 Program Manager, L-COG, Eugene, Oregon

Speaker Panel

Neil Mullane, Water Quality Division, DEQ, Portland, Oregon - "The DEQ and Urban Runoff Policy"

John LaRiviere, 208 Program Manager for Metro Service District, Portland, Oregon - "Urban Runoff Control Programs in the Portland Area"

Tim Miller, Urban Runoff and Hydrology Branch, USGS, Portland, Oregon - "Water Quality Monitoring and Urban Pollution Parameters"

John Russel, 208 Program Manager, Mid-Willamette Valley Council of Governments, Salem, Oregon - "Runoff Concerns, Monitoring and Impacts in the Salem Area"

Maxine Borcherding, Environmental Coordinator to the Mayor's Office, Portland, Oregon, on special assignment to the Environmental Protection Agency - "National Concerns With Runoff"

Roger Sutherland, CH2M-Hill, Urban Hydrology, Portland, Oregon - "Modeling Approachs and the Need for Integration of Runoff Control"

Thursday, April 3, 1980 -- 12:30-4:30 p.m.

Field Techniques - How Good are "Best Management Practices?"

These session will be devoted to providing practical information on several public works techniques and local problems. Information on state of the art of controls and benefits associated with street cleaning programs and detention/retention basins will be covered. In the presentations, some consideration will be given to relationships with air quality problems.

1. Street Cleaning Problems -- 12:30-3:00 p.m.

   A focus on past research, optimum techniques and quality of runoffs from streets. It will include a discussion of associated air quality problems.

   Speaker Panel

   Bob Pitt, Research and Technical Consultant to the National Urban Runoff Program of the EPA, Spring Green, Wisconsin - "State of the Art of Street Cleaning and Runoff/Air Quality Control"

   Maxine Borcherding, EPA/City of Portland Street/Air Quality Special Research Program - "Air Quality Concerns and Study Design for Runoff in Portland"

2. Sediment Detention and Retention Methods -- 3:00-4:30 p.m.

This session will focus on the design consideration limitations and benefits of sediment trapping by means of detention and/or retention. This session will particularly focus on water quality improvement and maintenance needs. There will be discussion of sediment problems associated with industrial site management.

Speaker Panel

Gayle Boyd, Woodward and Clyde, consultant to EPA (NURP) Programs, San Francisco, California - "Theory and Practice of Sediment Trapping

Gary Minton, Math Sciences Inc., Seattle, Washington - "Practical Sediment Trapping Processes in the Seattle and Portland Areas"

SESSION #2B:

Friday, April 4, 1980 -- 8:30-11:30 a.m.

1. Erosion Control and Track-Out Problems -- 8:30-10:00 a.m.

This workshop will focus on erosion control and the practical methods for enforcement of erosion ordinances.

Speaker Panel

Gary Minton, Math Sciences Inc., Seattle, Washington - "Practical Methods for Control of Sediment During Construction"

*Additional speakers to be announced

2. Open Channels, Vegetation Management and Natural Waterways -- 10:15-11:30 a.m.

This subject will focus on the problems associated with open channels, natural vegetation and marsh/pond systems. It will include information on the biology of these systems.

Speaker Panel

Gary Minton, Math Sciences Inc., Seattle, Washington - "Natural Control Techniques"

Tom Davis, Montgomery Engineers, Portland, Oregon - "March Pond Systems in the Ashland Watershed"

Gerritt Rosenthal, 208 Program Manager, L-COG, Eugene, Oregon - "Study Considerations for Vegetation Management on Open Channels in Eugene/Springfield"

Bill Sanville, EPA Water Laboratory, Corvallis, Oregon - "Physical and Growth Characteristics of Aquatic Systems in Western Oregon"

SESSION #3

Friday, April 4, 1980 -- 1:00-4:00 p.m.

Management and Financing Alternatives

This session will deal with various local and regional experiences with management and financing options for runoff management.

Speaker Panel

Chip Ullstad, City Engineer, City of Corvallis, Oregon - "Corvallis' Experience With a Runoff Service Charge"

Pam Bissonette, Storm Utility Director, City of Bellevue, Washington - "Storm Water Utility Design and Implementation"

Dick Warren; Kramer, Chin and Mayo Consultants; Seattle; Washington - "Options for Financing of Storm Water Management Programs"

We hope you will plan to attend and participate in the sessions. We do not have the financial and staff availability to make transcripts and detailed reports on the presentation so you may wish to take notes of the various sessions.

Please notify L-COG staff at least a week before the workshop if you will be attending. There are no registration fees.

FEEDBACK FROM URBAN RUNOFF MINI-WORKSHOP

RECOMMENDED POLICIES

- Reduce impermeable area
- Reduce rate and quantity of runoff
- Encourage increased vegetation overall
- Control construction-related sediment
- Encourage mass transit
- Encourage open drainageways
- Implement multiple use retension/detention basins
- Implement non-point source testing program
- Adopt strict hillside development and floodplain construction ordinances, e.g., Salem
- Prevention, at the source, of possible pollutants into waterways
- Balance of small and areawide detention basins that are readily maintainable

BMP COMMENTS

- Develop BMP's in proportion to pollution sources
- Non-structural BMP's are preferable
- In Western Oregon, quantity/quality controls will be more cost-effective
- Quality controls should be minimal cost (vegetation, erosion control)
- More guidelines, regulations or policies for designing and constructing revelments
- Develop local land management and construction ordinances and enforcement methods

WORKSHOP COMMENTS

- Sediment detention session, financial management, erosion control and vegetation management sessions were especially commended
- Street sweeping and modeling presentations may have been too sophisticated -- speakers could not answer managers' practical questions
- Exchange of local experiences was well received

- Good stress on practical experience
- Good cross-section of urban runoff scene
- Desire follow-up workshop after studies are completed
- Informative; gave details of concepts, BMP's that had not been heard before
- Could include broader input (beyond Public Works, e.g., Parks and Recreation for multi-purpose detention basis)

URBAN RUNOFF MINI-WORKSHOP

ATTENDANCE

NAME	ADDRESS	PHONE	AFFILIATION
David Van Dyke	3276 Commercial St. Salem, Oregon	585-2362	James M. Montgomery Engineers
Ken Hatch	1820 Roosevelt Eugene, Oregon	687-5244	City of Eugene
Eric Dittmer	33 No. Central Medford, Oregon	779-7555	RUCOG
Don Welkar	411 W. 8th St. Medford, Oregon	776-7485	City of Medford
Jerry Markesino	2929 No. Kergy Ave. Portland, Oregon	248-5515	City of Portland
John Russell	220 N.E. High Salem, Oregon	588-6177	Mid-Willamette Council of Governments
T. Goor	220 N.E. High Salem, Oregon	588-6177	Mid-Willamette Council of Governments
Jerry Shanbeck	P.O. Box 385 Oakridge, Oregon	782-2258	City of Oakridge
Bill Higbeo	125 Lawrence Eugene, Oregon	682-6446	USGS
Bob Barrett	346 Main St. Springfield, Oregon	526-3753	City of Springfield
Terry Smith	858 Pearl St. Eugene, Oregon	687-5289	City of Eugene
George Jessie	1820 Roosevelt Eugene, Oregon	687-5201	City of Eugene
Bill Clothier	1200 Sixth Avenue Seattle, Washington	442-1086 (206)	EPA
Michael E. Wilson	1820 Roosevelt Eugene, Oregon	687-5201	City of Eugene
Brian Shelton	858 Pearl St. Eugene, Oregon	687-5239	City of Eugene

Roger Nottage	362 No. 3rd Stayton, Oregon	769-3425	City of Stayton
Roger C. Sutherland	Portland, Oregon	224-9190	CH2M Hill
John R. Griffin	Portland, Oregon	248-5517	City of Portland Maintenance Bureau
John LaRiviere	Portland, Oregon	221-1646	Metro
Nat J. Mullane	P.O. Box 1760 Portland, Oregon	229-6065	DEQ
Timothy Miller	P.O. Box 3202 Portland, Oregon	231-2017	USGS
Michael Weinberg	Stayton, Oregon	769-2669	Santiam Water Control District
Bob Helling	1820 Roosevelt Blvd. Eugene, Oregon	887-5240	City of Eugene
Frank Mauldin	555 Liberty St. S.E. Salem, Oregon	588-6016	City of Salem
Ken Winckler	1820 Roosevelt Blvd. Eugene, Oregon	687-5221	City of Eugene
Ralph Johnston	16 Oakway Mall Eugene, Oregon	686-7618	LRAPA
Joe Lassites	16 Oakway Mall Eugene, Oregon	686-7618	LRAPA
Glen Grant	10 Swash Portland, Oregon	221-1814	Kramer, Chin and Mayo
Dick Warren	10 Swash Portland, Oregon	221-1814	Kramer, Chin and Mayo
Tom Stinchfield	City Hall II Eugene, Oregon	687-5233	Eugene Public Works Planning Division
Donald Thuerkoff	362 No. 3rd St. Stayton, Oregon	769-3425	City of Stayton
John E. Lofton	291 S.W. Mill Dallas, Oregon	623-6862	City of Dallas
Eric Nelsen	335 N.W. 18th Corvallis, Oregon	354-8787	City of Corvallis

John D. Thomas	4th and Main Springfield, Oregon	726-3753	City of Springfield
C. L. A. Scott	4th and Main Springfield, Oregon	726-3761	City of Springfield
William J. Gurley	City Hall II Eugene, Oregon	687-5239	City of Eugene
Robert Pitt	Route 1 Blue Mounds, Wisconsin	437-3435 (608)	SPL8 EPA (NURP)
Merlin Vilhauer	621 S.W. Alder St. Portland, Oregon	248-4630	City of Portland
Tom Davis	13265 S.W. Bay Meadows Ct. Portland, Oregon		Montgomery Engineers
Bill Gaffi	621 S.W. Alder St. Portland, Oregon		City of Portland
Ron Sunnarborg	621 S.W. Alder St. Portland, Oregon		City of Portland
Dan Brownson	621 S.W. Alder St. Portland, Oregon		City of Portland
Gary Minton	P.O. Box 1887 Bellevue, Washington	827-0460 (206)	Math Science N.W.
Carl Ferris	3421 25th St. S.E. Salem, Oregon	585-2474	Westech Engineering
Jerry Groff	3276 Commercial St. Salem, Oregon	585-2362	J. M. Montgomery Engineers
Paul McManus	350 Wilkie Eugene, Oregon	688-6424	City of Eugene WW Management
George Hall	364 No. 3rd Sataton, Oregon	769-3425	City of Sataton
Sally Sharrard	2nd & Broadalbein Albany, Oregon	967-4318	City of Albany
Chip Ullstad	City Hall Corvallis, Oregon	757-6941	City of Corvallis
Peter Eilers	200 S.W. 35th Corvallis, Oregon	757-4712	EPA Corvallis
Ted Boss	200 S.W. 35th St. Corvallis, Oregon	757-4712	EPA Corvallis

PSA #1

(STORM SEWERS)
TOPIC - WHERE DO (STREET DRAINS) GO

OBJECTIVE - Raise awareness that streets (and street dirt and soil) drain directly to important recreation areas* without treatment.

*Island Park, Alton Baker, Skinner Butte are of Willamette, Fern Ridge, Delta Ponds, Long Tom.

MESSAGE[1] - People at home and business should avoid putting wastes where they can easily drain to the street or a ditch.

IDEAL FOR VISUAL: Follow litter to street, then drainage way, then to park shore. Show other potential pollutants which could end up in storm sewer.

PSA #2

TOPIC: OIL

OBJECTIVE: Establish convenient oil disposal system and avoid disposal to storm sewer.

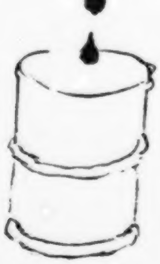
Prepare an oil repository logo for display at receiving stations.

SUGGESTED SCRIPT: Obvious fisherman walks up driveway next to car, turns to face camera.

"I've always changed the oil in my car right here in my own driveway. I never stopped to think where the old oil would end up. I'd just drain the oil out and pour it in the curb gutter. Then my neighbor told me that gutters empty into storm drains which dump right into our beautiful Willamette River where I go fishing. Chances are my oil was ending up in the river, too. He said there are places in town to take the old oil and and other disposable wastes, like paint, paint thinner, herbicides, pesticides, and any other potentially toxic material. So take you oil wastes to anyone displaying this symbol you'll be doing the river a favor.

Prepare a logo

→ e.g.



PSA #3

TOPIC: HILLSIDE CONSTRUCTION AND EROSION

OBJECTIVE: Demonstrate construction erosion problems and solutions - advertise a builders guide to reducing construction erosion.

SUGGESTED PROBLEMS TO PORTRAY BY PICTURES

1. Mud and dirt track out by construction equipment.

   SOLUTION: Lay temporary gravel base for equipment.

2. Land clearing exposes bare earth.

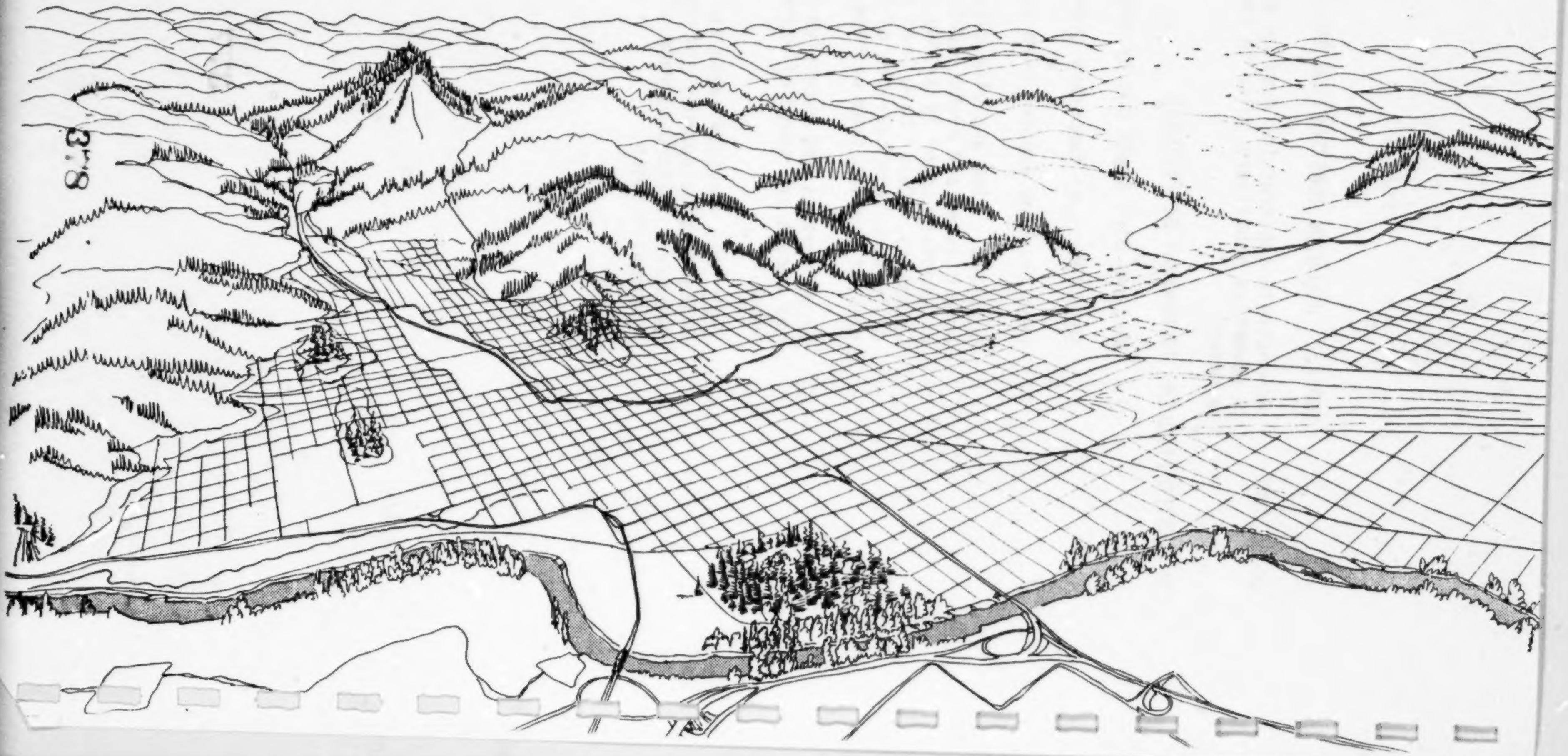
   SOLUTION: Time and plan clearing to minimize the area cleared and avoid exposure over winter. Plan a temporary cover if a long construction period is necessary. Cover bare land with straw or plastic. Build temporary barriers of straw or sand bags to prevent erosion from washing into streets.

3. Steep streets and excessive impermiable area increase the amount and speed of rainwater reaching city drainage ways.

   SOLUTION: Include areas for detention ponds in major hillside developments and encourage porous pavement. Temporary rooftop storage of rainwater and other innovative ideas.

BK:jt/C

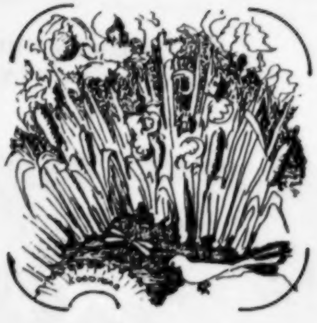
The Amazon Corridor



Is the Amazon an Opportunity?

From our point of view, the Amazon Creek represents an attractively under-utilized possibility among the natural features which penetrate the City. But the complexity of the circumstances which surround the Creek makes a rigorous analysis absolutely necessary to all stages of its study or any development proposal, such as a recreation corridor.

We are convinced by numerous wonderful precedents that the concept of country in the city -- in this case, corridor through the city -- has the potential to enhance communities and this enhancement is largely disproportionate to the simple area occupied by the corridor. We understand, in theory, that a linear, urban, recreation corridor will extend the usefulness, delight and capacity of each of the separate facilities which it connects, as well as offer access to recreation to segments of the City where opportunities have been limited by lack of proximity to a major resource.



But the passage from theory to a solid, defensible plan will depend upon the establishment of convincing evidence of feasibility. While the ideal of a greenway is attractive enough to justify itself, the feasibility of an Amazon greenway must be determined from cautious decisions weighed against criteria which are also deliberately cautious.

At this point in our study of the Amazon, certain criteria seem to be obvious. Considering all of the existing obstacles, the simple human need of the proposed corridor must be established. But, following from this, if community need, or usership should be established, it should then constitute the attractiveness of the whole project which gives meaning to all other aspects.

Second, to human need is the actual physical opportunity of the corridor. Does the physical situation actually offer a solid possibility for recreation? Can the many uses of the corridor co-exist? Can the land or rights be acquired? Does the hydrology present unsolvable problems?

These questions along with [illegible] of the supporting technical documentation from the basis of a first cut at feasibility determination. They answer the logical, broad questions, 'Who needs it?' and 'Is it possible?'

The importance of demonstrating economic practicality -- at least to the extent of identifying possible financial opportunities -- lies clearly with any proponent of an idea as far-reaching as this. Then too, one of the most critical aspects of feasibility will be the willingness of the various jurisdictions to co-operate toward adjusting their traditional modes to make room for an idea which may well fall outside the operations of any one agency. Willingness to undertake what may become a joint venture for City and County may well be a critical impediment or energizer in the entire process. In the same sense, neighborhoods who stand to be affected by the corridor must be willing to demonstrate their position conclusively.

[illegible]en a g[illegible] of peo[illegible]vocat[illegible]ea which grows from their special, professional sensitivities, it is usually an idea whose merit will manifest itself through large sections of their community. The Amazon corridor is a special idea whose merit lies in its connectedness to almost all of the City, in its aspect of making something from almost nothing, and its potential to become part of the solution to a battery of our urban problems.

Water Quality and the Amazon

The federal water pollution control act amendments of 1972, is another one of the many factors that "ask" the community to reexamine the Amazon for potential uses other than flood control.

Described below are a set of current circumstances which will make the above statement clearer.

1. The 1972 Act established an notional goal, in Section 101 (a), to "achieve water quality which provides for the protection and propagation of fish, shellfish, wildlife, and provide for recreation in and on the water.." It also states, "that streams and rivers will be swimable and fishable by 1982". Furthermore Section 208 of the Act, requires a designated agency to engage in a planning process to identify water quality problems, due to point and non-point sources, and to develop a comprehensive program to manage these activities that effect water quality.

2. The Amazon is an urban stream which drains, almost, the whole of Eugene into Fern Ridge Reservoir (a contained and controlled part of the Long Tom River basin system).

3. Fern Ridge reservoir, although primarily designated for irrigation and flood control purposes, has become a major regional recreational feature for Lane County.

4. The Amazon's current alignment and construction is almost exclusively a result of flood control planning and design efforts.

5. Urban pollutants (sediments, chemical contaminants) are entering the Amazon and are being carried to Fern Ridge reservoir. This is especially acute during peak storm runoff periods.

6. Current land use policies of the City of Eugene and Lane County encourage the increased density of Eugene. With increased density comes the potential for increased water quality problems.

7. Although there are a variety of measures which will need to take place simultaneously to counter water pollution problems, management and design of the Amazon will most certainly be a central element of any water pollution control program.

8. An October, 1977 L-Cog report on urban storm runoff recommended the following:

   a. Open channels are an effective urban runoff and pollution control device. They can be designed to help prevent peak runoffs and pick up pollutants.

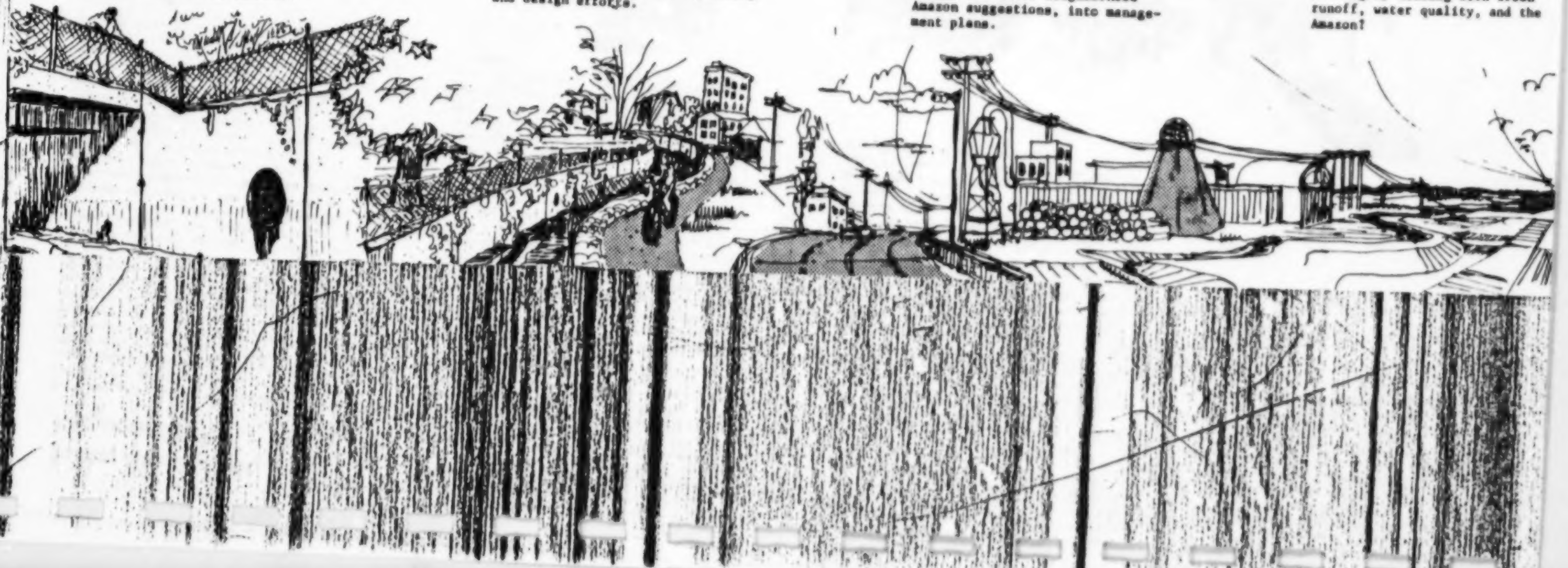
   b. There is a need to develop a public awareness of the multiple resource values of the open channel systems as well as general urban storm runoff and to incorporate the public concerns, desires, and local neighborhood Amazon suggestions, into management plans.

There are still many questions to be answered concerning the relationships between waterquality, the Amazon, and other possible multiple uses for it.

A. Is the Army Corps of engineers responsible for the swimableness and fishableness of Fern Ridge reservoir? If so, how are they involved with water quality planning for the Amazon drainage?

B. How is the city of Eugene involve in water quality planning? (It contributes the largest share of the pollutants and runoff and it has contractual jurisdiction over it).

C. How is the D.E.C. (E.D.A.'s agent in Oregon) dealing with urban runoff, water quality, and the Amazon?



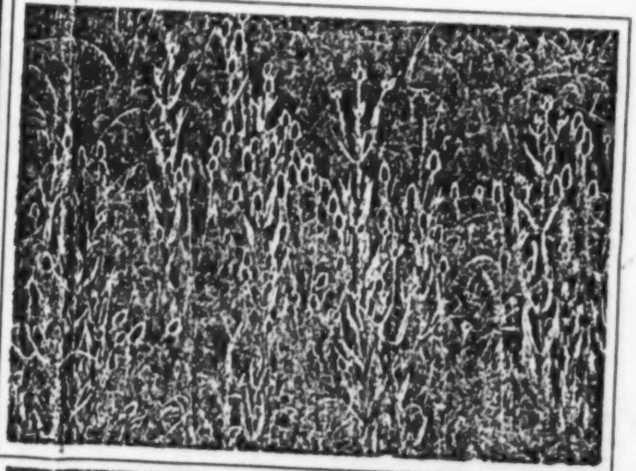
ugene Register-Guard
UGENE, OREGON, SUNDAY, JULY 10, 1977

Area News

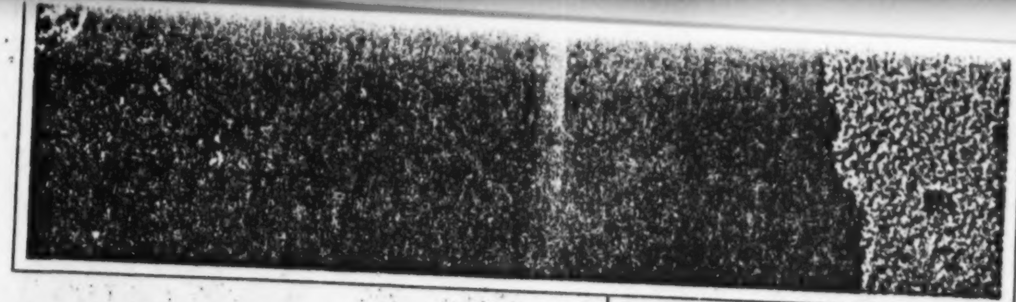
The Forgotten Thoroughfare

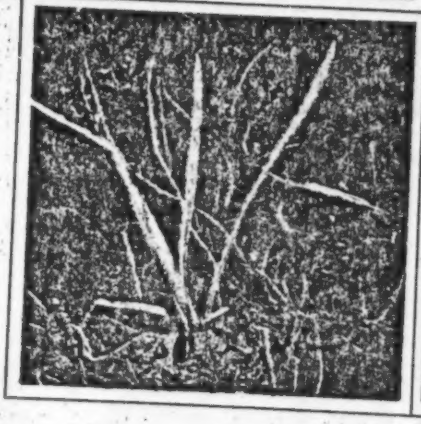
by DEAN BAKER

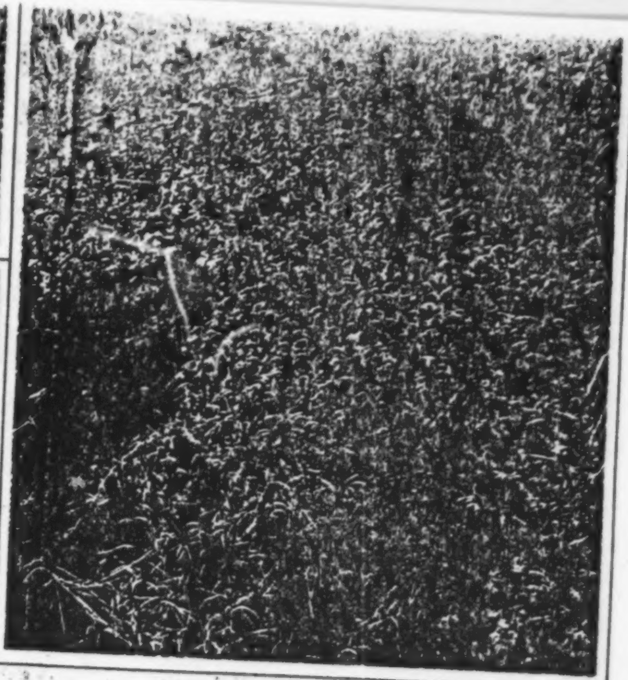
photos by WARREN MORGAN
of the REGISTER-GUARD



Reproduced from
best available copy.







All but unnoticed, the Amazon wanders through our town, nourishing a swampy wonderland and a reservoir to the west. It could, some say, revitalize the city.

IT'S PROBABLE THAT few people ever give a second thought to the little stream that trickles down off Spencer Butte and then meanders for miles through the heart of Eugene.

Former Oregon Fourth District Congressman Charles Porter, a Eugene attorney, is one of the few.

Porter thinks the swampy little waterway — the one that is variously called Amazon Creek, the Amazon Slough, the Amazon Channel or simply The Amazon — is part of a great untapped resource in this community, one link in Eugene's forgotten thoroughfare.

Thoroughfare?

As usual, Porter has a grand idea cooking here, the kind that's tasty but hard to swallow without laughing. It has an appealing flavor to it, though, that has a way of staying on your mind. His idea?

He'd like to see "a city corporation" or "some private investor" dig an open canal 11 blocks long across central Eugene, a few blocks west of the university. The canal would connect the Amazon and the Millrace, Eugene's other semi-stagnant downtown creek.

"The canal could save our dying downtown," Porter said flatly in a recent interview.

The new canal should be navigable by canoes and small boats with electric motors, he said. A "promenade" should be built along its banks so bicyclists and pedestrians could roll and stroll along its length, which should be lined with shops, cafes, entertainment spots and high-rise apartment buildings, in Porter's view.

The whole project should be designed to move people downtown in Eugene and keep them there, he said. "I haven't raised the money yet, or I'd do it myself, right now," he added, as if to lampoon himself quickly before someone else seized the chance.

However, Porter said he is just as serious about the canal as he is about his other favorite big business idea — a proposal for a restaurant atop Skinner's Butte, with access by cable car.

Are the ideas just Porter's folly, or are they important?

Porter said they are the kind of ideas Eugene needs.

"The problem is that our downtown has no feature," he said, seriously. "If you had a feature like this great canal — let's call it the Eugene Canal; no, call it the Emerald Canal — you'd have a base of support for the downtown.

"The answer to increasing the use of downtown is to have people living there," Porter said. "Tokyo, San Francisco — all the great cities of the world have people living there. Now here, there is nothing open downtown at night. Why not?"

He answered his own question.

"Because nobody is downtown. But if you had high-rise apartments, little shops, little bars, and if you could walk right out on a promenade and get into a canoe, you'd have a feature."

Not everyone is enthusiastic about the idea, however. Two years ago, Porter wrote a letter to the city council laying out the canal suggestion. Nothing happened — not even a public discussion.

"I recall the letter," Asst. City Manager Keith Martin said recently. "It was accepted as an idea to be considered, but there were problems with it in terms of priority compared to other issues, funding and questions about whether we could divert the Amazon."

The apparent complexity and expense of securing right-of-way for the canal and then building it pushed the letter into a file at city hall, Martin said. "Our reaction was, 'Hey! That's an idea!' " he said. "And then. . . ."

So the idea was put on ice, as similar notions have been for at least 20 years. Back in 1957, an 18-member citizen committee representing the University of Oregon, the Eugene City Council, the Yacht Club, the Garden Club and the Hunt Club met to try to encourage installation of a diameter siphon pipe six feet in diameter from the Millrace, approximately at 10th and Mill streets, to the Amazon in the vicinity of 17th and High streets — a distance of 3,600 feet.

The committee wanted to speed up the Millrace flow, provide more water for irrigation and industry west of Eugene, improve the summer sanitary conditions by flushing out the Amazon and raise the summer level of Fern Ridge Reservoir by taking water out of the Willamette, running it through the Millrace, the pipe and the Amazon.

The idea didn't go anywhere then and although it's been revived a few more times since, it's still just an idea. Today, it makes some public servants yawn.

"I hope you're not going to bring that up again, are you?" asked Eugene Public Works Director Don Allen, responding to a reporter's inquiry about the feasibility of Porter's idea. "We wouldn't be able to seriously plan such a project unless the money was available."

Charles Porter . . . *has an idea*

How much? Neither Allen nor other public officials would attempt a guess. But Allen said he believes few government agencies would be willing to provide the necessary capital for that kind of improvement — not when America is filled with worse urban problems the Eugene's failure to make any kind of useful attraction out of its two rather charming streams.

So development of a canal remains largely one man's dream, although development of the Amazon itself is apparently more than just an idea.

Ernie Drapela, the city's assistant parks director and chairman of the Oregon Advisory Bicycle Committee, said recently the metropolitan bike committee has a visionary

Please turn to Page 2E

EUGENE, OREGON, SATURDAY, NOVEMBER 18, 1978

CITIZEN OF ITS COMMUNITY.

Eugene RegisterGuard

Waterways scheme in test phase

By AL CURREY
Register-Guard Associate Editor

A multi-faceted proposal to give Eugene a system of scenic waterways — and to provide a basketful of important side benefits — has moved $60,000 closer to realization.

That leaves it millions of dollars, and no doubt many years, short of becoming reality. But it is now assured that the U.S. Army Corps of Engineers will investigate the key premises involved in this proposal which, among other things, envisions connecting the Millrace and Amazon Creek via a canal through the central business district.

This was cause for rejoicing, and more, Thursday night at the organizational meeting of the Emerald Canal Steering Committee. After a color slide presentation by Jerome Diethelm, University of Oregon professor of landscape architecture, informational pamphlets were distributed to an audience that included townspeople, university students and, as onlookers, representatives of several interested city and county agencies. And then, with Charles Porter as its enthusiastic chairman, the committee began preparations for an early meeting with Army Engineers who'll use $60,000 of Uncle Sam's money to determine:

- If, without lowering the river too much in its low run-off periods, water can be diverted or pumped year-round from the Willamette River to make Eugene's long-neglected Millrace a free-flowing stream again.
- What recreation and irrigation benefits would be gained from then connecting the Millrace and Amazon Creek and in this way keeping Fern Ridge Reservoir full all year round.
- And, whether or not, during periods of excessive rain, the effectiveness of Amazon Creek as a flood relief channel could be increased by — hold onto your hat — using its downtown connection to the Millrace in reverse fashion, to discharge some of the Amazon's runoff into the Willamette.

Favorable findings on these points will establish the basic feasibility of a fantastic waterways system in Eugene. Dreams of a revitalized Millrace that a number of Eugene residents have entertained for years will take on new luster.

Simultaneously, the idea that downtown Eugene might be enhanced and made more livable through a canal-building project will gain at least enough plausibility to merit further investigation. And a relatively new thought that the sometimes stagnant, often unsightly Amazon Creek might be converted into an exceptionally valuable recreation and area-beautification asset — all the way from Spencer Butte to Fern Ridge — will become almost dazzling.

The combination of those far-reaching possibilities led Oregon's Sen. Mark Hatfield to seek a congressional appropriation to finance the Army Engineers' study. It has also induced the Eugene City Council and the Lane County Board of Commissioners to endorse the Emerald Canal Steering Committee's effort to familiarize local residents with its waterways system concept.

The map printed above shows only the downtown business district portion and three possible routes for an "Emerald Canal" proposed by UO landscape architecture students who worked on the waterways proposal as part of their training under Diethelm. It's intriguing all by itself. But portrayal of everything involved in their grand scheme would require pages of maps, drawings and pictures.

Diethelm became stirred with the potentials of Eugene's Millrace and Amazon several years ago after seeing the imaginative uses to which similar waterways are put in Europe. Since then, he and his students have even gone so far as to determine land ownerships that would be involved in a Millrace-Amazon project. They've estimated the main costs of such a project as $10 to $18 million, depending upon the number of embellishments. They've also identified possible sources of financing, including state and federal aid and the possibility of assessments on benefited private properties.

The proposal that has emerged from all of this is not really an all-or-nothing package. However, in its complete grandeur it includes such possibilities as the development of small recreation lakes in Amazon Park and at other locations along Amazon Creek's 12-mile run from the foot of Spencer Butte to Fern Ridge. These would also serve as impoundments for drainage from Eugene's South Hills where residential construction is increasing flood runoff problems and beginning to overtax the Amazon's capacity in winter months.

Small parks, interconnected with bike paths, might be developed all along this "Amazon corridor." Similarly, parks, scenic bridges, pedestrian walkways and bike paths might be added features of the downtown Emerald Canal and the restored Millrace.

The recreation benefits that Diethelm, his students, Porter and others foresee include uninterrupted boating and swimming at Fern Ridge, where the water level is now drawn down in late summer to maintain irrigation supplies downstream on the Long Tom River and the Willamette. The project they hanker for would allow birds to nest in the reedy marshes around Fern Ridge that now go dry in summer. Fish life in the reservoir would be be benefited too, they say, and it's possible that farmers along the Long Tom could be provided additional irrigation flows.

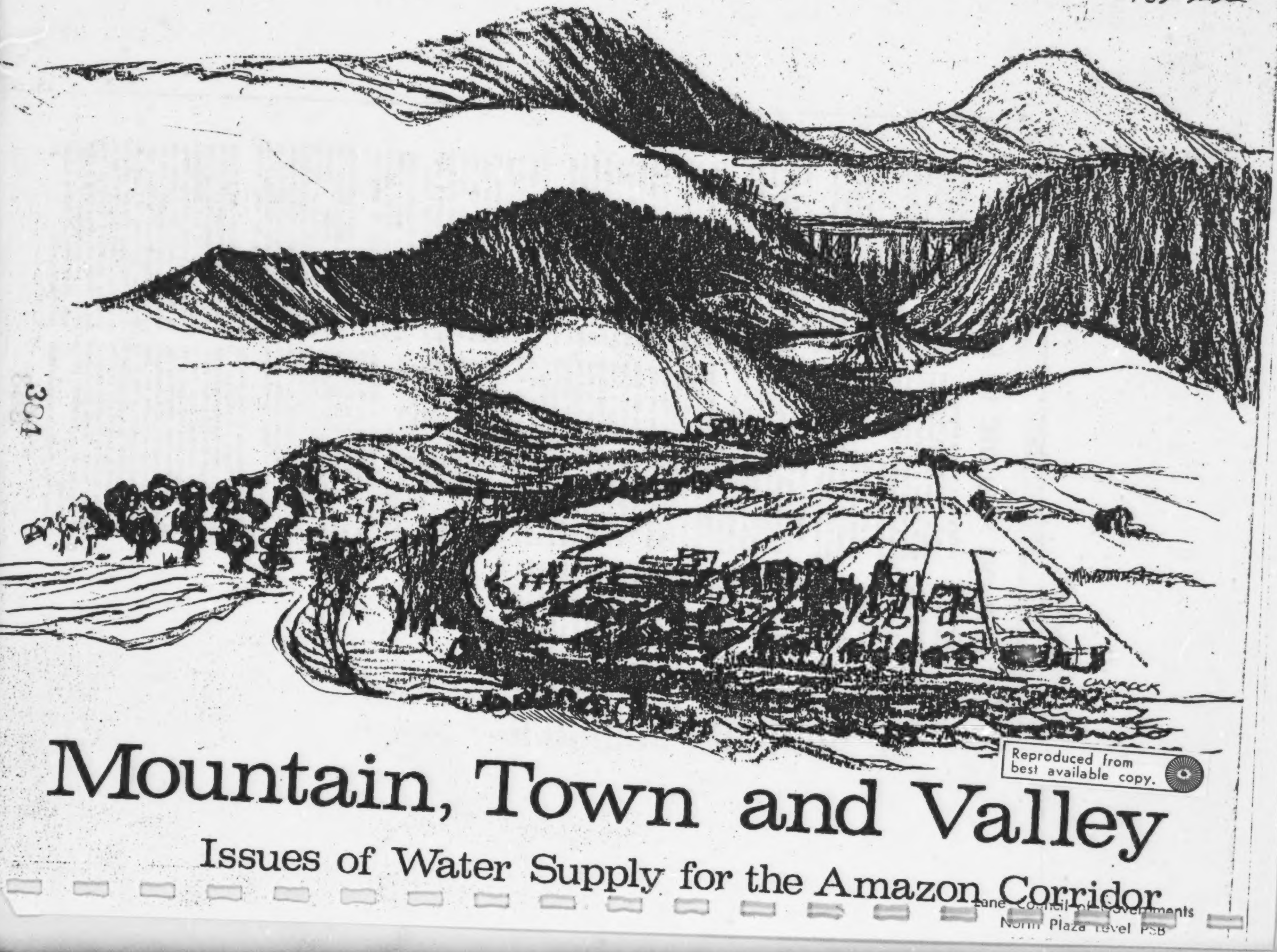
Porter and Diethelm speak of urban renewal in the West University district as another benefit that might come in conjunction with the Emerald Canal, and of restaurants, retail stores, and apartment houses on attractive canal-side sites. Two cities in Texas have made such beautification improvements, and officials in those cities have already indicated willingness to share their how-to experience with Eugene.

Finally, of course, there are possibilities that waterways through Eugene would be extensively used for pleasure boating, perhaps even for some commuting.

Eugene's department of public works has found that a plan to connect the Millrace and the Amazon by routing flows through city storm sewers involves too much risk of flooding basements and of adding to groundwater problems. Those lines simply were not built to withstand the pressure that would be developed by so much water flowing through them.

As indicated earlier, the Emerald Canal Steering Committee may find its proposal quickly sidelined if the Army Engineers come up with fundamental reasons it won't work. However, assuming that the initial investigations are encouraging, this committee could become a gathering force in future planning for the betterment of Eugene. Financing their entire proposal would be no overnight undertaking. But, if the engineering practicality is proved, refitting Eugene's long-range plans to allow for eventual development of a waterways system could be both a popular and a prudent move.

Garrett Rosenthal

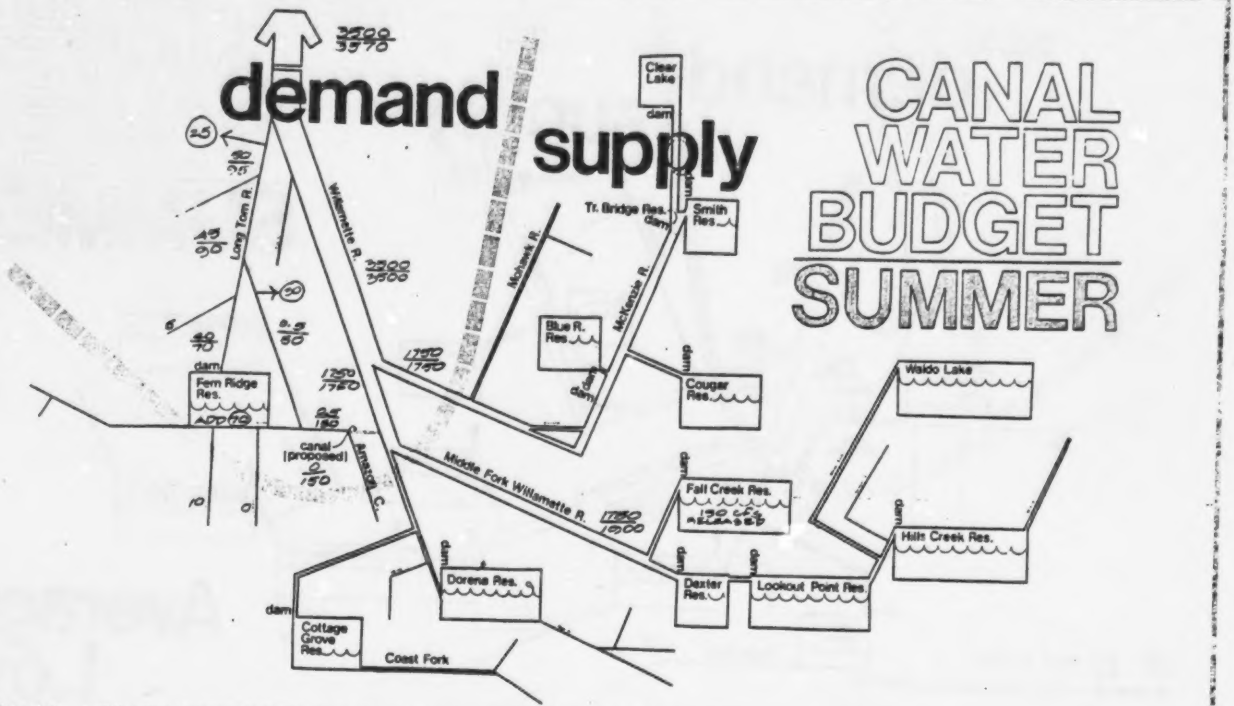


Reproduced from
best available copy.

Mountain, Town and Valley

Issues of Water Supply for the Amazon Corridor

Lane Council of Governments
North Plaza level PSB

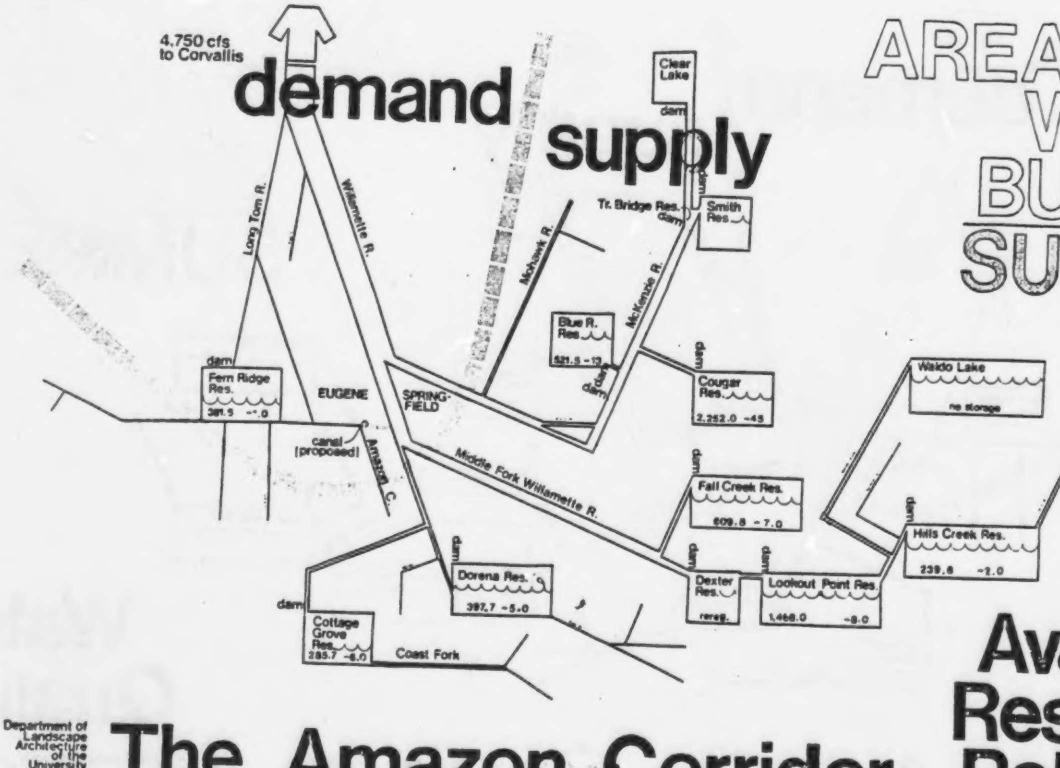

3500/3570
demand
supply
25
30/25
45/90
Long Tom R.
Willamette R.
3500/3500
30
6
8.5/50
40/70
dam
Fern Ridge Res.
ADD 70
1250/1750
25/150
canal (proposed)
0/150
Amazon C.
10
0
1750/1750
Mohawk R.
McKenzie R.
Clear Lake
Tr. Bridge Res.
Smith Res.
Blue R. Res.
Cougar Res.
Middle Fork Willamette R.
1750/1000
Fall Creek Res.
170 cfs released
Waldo Lake
Hills Creek Res.
Dexter Res.
Lookout Point Res.
Dorena Res.
Cottage Grove Res.
Coast Fork

CANAL WATER BUDGET
SUMMER

Department of Landscape Architecture of the University of Oregon

The Amazon Corridor

Allocation Proposal


4,750 cfs to Corvallis
demand
supply
Long Tom R.
Willamette R.
dam
Fern Ridge Res.
381.5 -0.0
EUGENE
SPRINGFIELD
canal (proposed)
Amazon C.
Mohawk R.
McKenzie R.
Clear Lake
Tr. Bridge Res.
Smith Res.
Blue R. Res.
521.5 -13
Cougar Res.
2,252.0 -45
Middle Fork Willamette R.
Fall Creek Res.
609.8 -7.0
Waldo Lake
no storage
Hills Creek Res.
239.8 -2.0
Dexter Res.
rereg.
Lookout Point Res.
1,468.0 -8.0
Dorena Res.
397.7 -5.0
Cottage Grove Res.
285.7 -6.0
Coast Fork

AREA-WIDE WATER BUDGET
SUMMER

Department of Landscape Architecture of the University of Oregon

The Amazon Corridor: Available Reservoir Releases

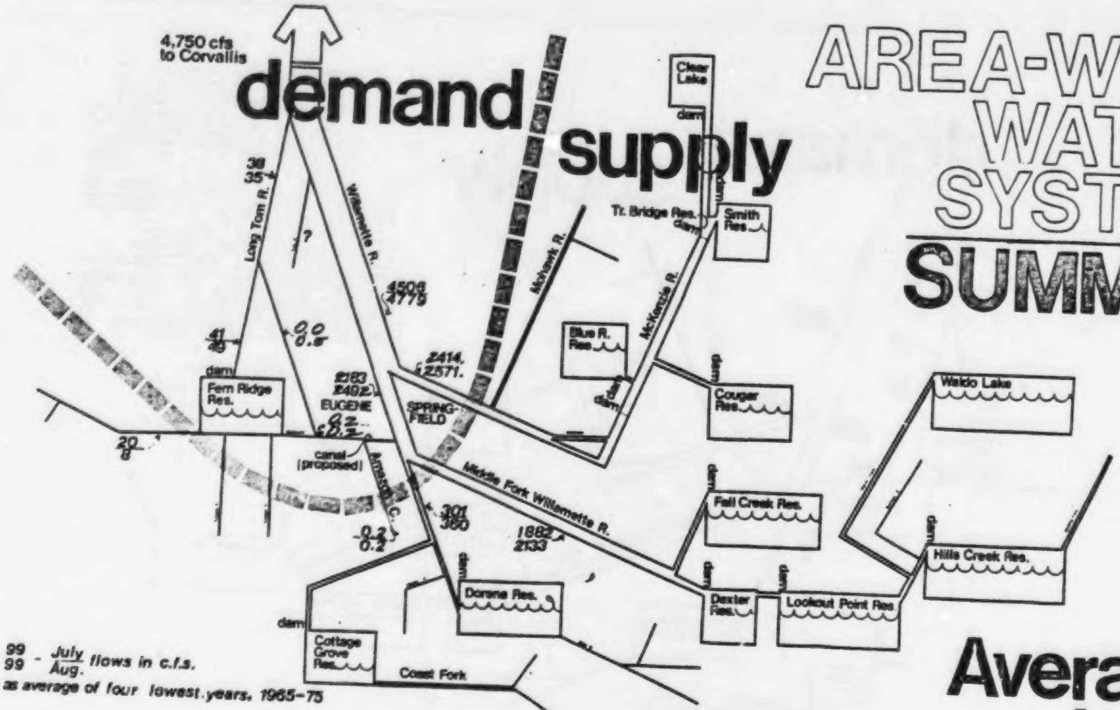
in millions cubic feet with drawdown in feet

SOURCE: PORTLAND DISTRICT CORPS OF ENGINEERS U.S. ARMY.

FIGURE 9.

AREA-WIDE WATER SYSTEM

SUMMER


4,750 cfs to Corvallis
demand
supply
Clear Lake
dam
Tr. Bridge Res.
dam
Smith Res.
dam
Mohawk R.
McKenzie R.
Blue R. Res.
dam
dam
Cougar Res.
dam
Long Tom R.
Willamette R.
38
35
?
4506
4779
41
49
0.0
0.8
2414.
2571.
2183
2492
EUGENE
SPRING-FIELD
0.2
0.2
dam
Fern Ridge Res.
20
8
canal (proposed)
Amazon C.
Middle Fork Willamette R.
301
360
1882
2133
-0.2
0.2
Waldo Lake
Fall Creek Res.
dam
Hills Creek Res.
dam
Dexter Res.
dam
Lookout Point Res.
dam
Dorena Res.
dam
dam
Cottage Grove Res.
Coast Fork

99 - July
99 - Aug. flows in c.f.s.
as average of four lowest years, 1965-75

Department of
Landscape
Architecture
of the
University
of Oregon

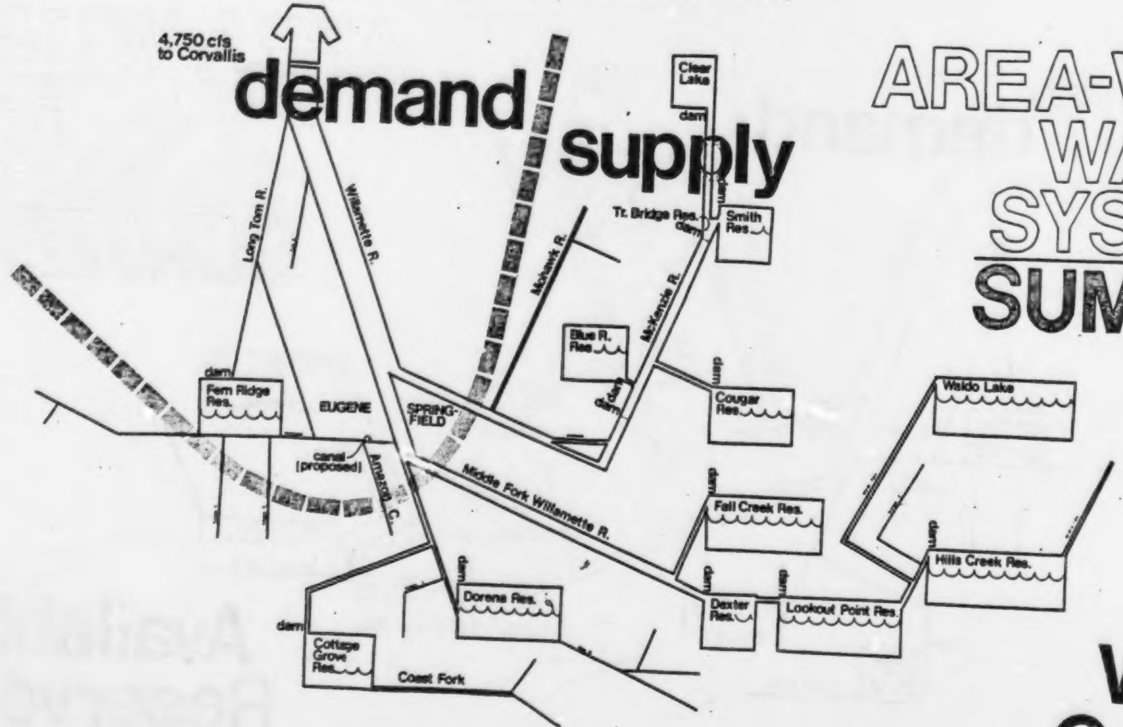
The Amazon Corridor: Average Low Flows

SOURCE: U.S.G.S. WATER PAPERS FOR OREGON, YEARS 1964-1975

FIGURE 5

AREA-WIDE WATER SYSTEM

SUMMER


4,750 cfs to Corvallis
demand
supply
Clear Lake
dam
Tr. Bridge Res.
dam
Smith Res.
Mohawk R.
McKenzie R.
Blue R. Res.
dam
dam
Cougar Res.
dam
Long Tom R.
Willamette R.
dam
Fern Ridge Res.
EUGENE
SPRING-FIELD
canal (proposed)
Amazon C.
Middle Fork Willamette R.
Waldo Lake
Fall Creek Res.
dam
Hills Creek Res.
dam
Dexter Res.
dam
Lookout Point Res.
dam
Dorena Res.
dam
Cottage Grove Res.
Coast Fork

Department of
Landscape
Architecture
of the
University
of Oregon

The Amazon Corridor: Water Quality Hazards

SENATOR MARK O. HATFIELD (R-OREGON) Washington, D.C. 20510 202 224-57

Steve Hickok
503-221-6374

Date: For release Tuesday, October 24

Amazon Creek/Fern Ridge Lake Study

Senator Mark Hatfield announced today that the Army Corps of Engineers will begin a study of possible water supply and water quality improvements for Amazon Creek and Fern Ridge Reservoir. The Corps' interest in these subjects was reactivated through a Hatfield amendment to this year's appropriations bill for energy and water development.

The Senator said in Eugene today that his action was in response to "many concerns expressed by the people of this area about water supply to keep Fern Ridge reservoir high all summer for recreational boating, and about better water quality for Amazon Creek." He added, "We are going to see about exploiting a relationship between the two."

Hatfield said the possibility for assisting both interests was brought to his attention by Jerry Diethelm, head of the Landscape Architecture Department at the U of O. Diethelm and students in his department have been working on a plan to restore the Amazon Corridor through Eugene to a park-like environment. The plan envisions summer augmentations of water in Amazon Creek by upstream diversion from the Willamette River. Below Eugene, this diversion could be channeled into Fern Ridge Lake, thus acting to offset normal summer water losses at the reservoir due to evaporation and releases for irrigation and fish and wildlife maintenance.

Hatfield said $60,000 will be available to the Corps in this fiscal year to begin the study.

IN THE BOARD OF COUNTY COMMISSIONERS OF LANE COUNTY, OREGON

RESOLUTION 79-1-17-2) THE LANE COUNTY BOARD OF COMMISSIONERS
) UNANIMOUSLY SUPPORT THE AMAZON CORRIDOR
) PROJECT

WHEREAS, the Lane County Board of Commissioners finds the Amazon Corridor Project will improve the environment of several neighboring areas, and

WHEREAS, the Amazon Corridor will provide better irrigation and be an economic stimulus to the citizens of Lane County, and

WHEREAS, the Amazon Corridor will provide transportation recreation and better utilization of a waterway enhancing the wildlife and scenic opportunities,

BE IT RESOLVED, the Lane County Board of Commissioners approves in principle the proposal for the Amazon Corridor.

BE IT FURTHER RESOLVED, the Lane County Board of Commissioners will designate an appropriate person to work with the City of Eugene and the state and federal agencies to bring about planning efforts for the program.

Dated this 17th day of January, 1979.

Vance L. Freeman
Vance L. Freeman, Chairman
Lane County Board of Commissioners

Gerald H. Rust, Jr.
Gerald H. Rust, Jr., Commissioner

Otto A. t'Hooft, Commissioner

Harold H Rutherford
Harold H. Rutherford, Commissioner

Archie Weinstein
Archie Weinstein, Commissioner

APPROVED AS TO FORM
Date 2-1-79

June 30, 1980

TESTIMONY TO THE OREGON WATER POLICY REVIEW BOARD

Comments on Water Quality Aspects of the Proposed 200 cfs. Diversion from the Willamette River by Lane County

My name is Gerritt Rosenthal, 87322 Cedar Flats Road, Springfield, Oregon, and I am speaking on behalf of the 208 Areawide Water Quality Program for the Lane Council of Governments. Although I am also a member of the Emerald Waterways Citizens Committee, my comments here are in regard to the wide range of water quality considerations of this porposed withdrawal and not as a proponent of the project.

I would like to briefly address five separate water quality issues and will summarize here my rather more lengthy analysis, which can be made available to the Board if desired. I would be happy to respond to questions.

The five major quality issues are:

1. The impact of 200 cfs. flow reduction on the quality of the Willamette River in two reaches; from withdrawal to the McKenzie confluence and from the McKenzie to the Long Tom confluence;
2. The impact of the withdrawal on the water quality in the Amazon Creek and Fern Ridge Reservoir;
3. The impact of the diversion on potential Long Tom flow augmentation and quality;
4. The impact of the reintroduction of withdrawn water via the Long Tom back to the Willamette; and
5. The impact of spring, summer and fall urban storm runoffs on the quality of the Diversion and on Amazon Creek and Fern Ridge Reservoir.

In addressing these issues, several assumptions have been made.

First - Diversion at full volume is expected only during the April-October period since the channel is also intended for flood control purposes. Winter diversion may be 10-20% of summer flow.

Second - It is assumed for purposes of analysis and discussion that no additional storage release augmentation is authorized. This represents a "worst case" situation and is helpful mainly for purposes of illustration. Since it appears that in fact such flow augmentation is an authorized use of Lookout Point Reservoir, and since the water is indeed available, it is highly likely that this release will virtually eliminate the potential negative impacts I will mention.

Third - It is assumed, and L-COG staff would suggest, that under conditions of severe drought or major pollutant discharge that extraordinary measures be taken for protection of Willamette River quality, including greater augmentation of flow and partial restriction of the proposed withdrawal under the "junior water right" principal. This process would come into play anytime flows in Albany drop below, for example, 4000 cfs.

Finally - The following parameters were assumed to proved a good measure of water quality and were the major ones used in analysis: Flow, Temperature, B.O.D. (as an estimate of Salem D.O.), C.O.D., Phosphorous, Total Solids and Fecal Coliform.

ISSUE #1 REGARDING THE IMPACT ON THE WILLAMETTE RIVER:

The major impact is due to higher temperatures caused by lower flows. Normal flows in Eugene are around 1700 cfs. with 10 year lows in the 800-1200 range. (See attached chart). A 200 cfs. diversion is a loss of 12% (normal year) to 25% (extremely low) of river volume. Under normal years, this could result in a 2 degree C. temperature increase from about 17 degrees to 19 degrees by the end of the 10 mile reach before confluence with the McKenzie (see chart). Following confluence and mixing with the much colder McKenzie water, a much smaller increase is anticipated, (0.8 degrees C) and as the chart shows, in neither case is a critical temperature (20 degrees) problem indicated. As was noted earlier, an additional flow augmentation would nullify these impacts.

A second concern on the Willamette is the availability of water for waste dilution of the Eugene-Springfield STP (in progress). This plant is scheduled to discharge 77 cfs. of 10 ppm BOD. Currently, at 1500 cfs. in the river, this will cause an increase from 1.5 to 1.9 ppm. B.O.D. With the proposed diversion, the predicted increase is from 1.5 to 2.0 ppm. (see chart). This would seem to be a minor impact and still well below standards for B.O.D. for good quality.

In short, it seems that without additional flow augmentation, the impacts of the diversion are noticeable although not unacceptable, and should not limit beneficial uses. These negative impacts should decrease after confluence with the McKenzie because of the high quality and volume of that river and should be nearly insignificant in the 45 miles between the McKenzie and the Long Tom. Flow augmentation is still recommended, nonetheless.

ISSUE #2 REGARDING IMPACTS ON THE AMAZON AND FERN RIDGE RESERVOIR:

I would draw your attention to the top two bars on each set of charts. The Willamette River diversion water is much higher quality than the Amazon at summer background flows. Because normal Amazon flows are 2-5 cfs. it is expected that 200 cfs.of river water will result in canal quality only 5-10% below that of the WillametteRiver, excluding the impacts of storms and recreational uses.

The travel time for the 10 miles to Fern Ridge should be about 12 hours at 1.5 ft/second and although heating will be significant, this water should remain below 20 degrees C. and may be cool enough for trout and other cool water species.

The impact on Fern Ridge cannot be predicted at this time because of a lack of data and understanding of the mixing characteristics of this large, shallow water body. L-COG has recently applied for a Clean Lakes Grant to gather the data to analyze Fern Ridge mixing and pollution.

It might be noted that the input of this cooler, less nutrient-rich water (compared to Coyote Creek and Long Tom, the main sources) may help control algae on Fern Ridge in a manner similar to the input of 200 cfs. of Columbia River water to Moses Lake in E. Washington. It is also possible that lake levels may be raised 6" to 1' during parts of the summer, and this could decrease turbidity by reducing wave action on bottom mud.

ISSUE #3 IMPACTS ON THE LONG TOM:

This issue, relative to impacts on the Long Tom, depends on the impact on Fern Ridge and cannot really be predicted at this time. However, it is clear that more water will be available for flow augmentation, somewhere between 100 and 150 cfs., and so the very serious low flow and temperature conditions on the Long Tom will be alleviated. It may also be that the overall river quality will be enhanced due to increased dilution of agricultural land runoffs. (A comparison of the top and middle lines on each group of bars shows the relative quality of the proposed Diversion and existing Long Tom quality).

ISSUE #4 REINTRODUCTION OF DIVERSION WATER

Perhaps of most difficult water quality issue to judge is that of the reintroduction of diversion water back to the Willamette. It is assumed that between 25 and 75 cfs, say 50 cfs, of the diversion water will be consumed by irrigation seepage, evaporation and transpiration. It is also assumed, and this is a "worst" case assumption, that the quality of the Long Tom will not be improved from currently except for temperature, in other words, all the current "enrichment" of the Long Tom is from Fern Ridge and not agricultural or livestock impacts.

A comparison of water quality currently in the Long Tom versus that in the Willamette @ Harrisburg shows some disperity in quality primarily in regard to doubled B.O.D.s and C.O.D.s and 20% increases in phosphate, solids and dissolved materials. At this point, the higher volume of the Willamette (3500-4500 cts.) provides a significant (20 to 30 to one versus the 150 cfs. of Long Tom Water) dilution and with C.O.D. this calculates to be approximately a 10% increase in loading or a 0.5 ppm. concentration increase.

Additional flow augmentation of 200 cfs. will slightly reduce this reintroduction impact.

Finally, regarding ISSUE #5, RUNOFF QUALITY, it is instructive to compare water quality in all of the streams versus storm discharge in the Amazon (see chart). The data shows a storm condition of 200 cfs. that can be predicted to happen once a year from May through October. B.O.D. is seven times higher, C.O.D. ten times, $P.O._4$, solids and coliform, five times plus the discharge will contain oil, grease, toxics, etc.

L-COG is currently involved in a study to refine the impacts of these pollutants and to predict whether they are felt in the channels, Fern Ridge or in the Willamette River.

Our current 'best guess' is that a large portion of these storm pollutants currently is trapped in Fern Ridge and this would continue to be the case. It is not clear that there would be an increase in "through-flow" in Fern Ridge.

At any rate, it seems obvious that special efforts will be necessary to reduce pollutant loadings to the diversion and to the Amazon system. The potential for recreation conflicts will necessitate a more vigorous runoff control and channel operation and maintenance effort. Some of these pilot techniques are currently being studied by the cities and L-COG as part of an urban runoff management program, including sedimentation and vegetation management.

Suffice it to say that the Amazon quality will be improved by the diversion, but that control of runoffs will limit beneficial use development.

Runoffs to the Willamette River are another concern. In this case, the fact that rainfall usually is infrequent during the lowest flow and highest temperatures is a partially mitigating factor. Greater efforts of runoff control and additional storage release are recommended.

The current level of analysis is, of course, inadequate, and a greater analysis of the identified concerns would be in order.

IN SUM: Impacts on the Willamette are noticeable, but probably not sufficient to seriously impair beneficial uses, particularly fisheries. Impacts on the Amazon, Fern Ridge and the Long Tom are quite significant and beneficial. Flow augmentation and runoff management should accompany the diversion project.

GR:nc/C
ATTACHED CHARTS

Presented at Public Hearing, Eugene.
June 30, 1980

Gerald Rosenthal

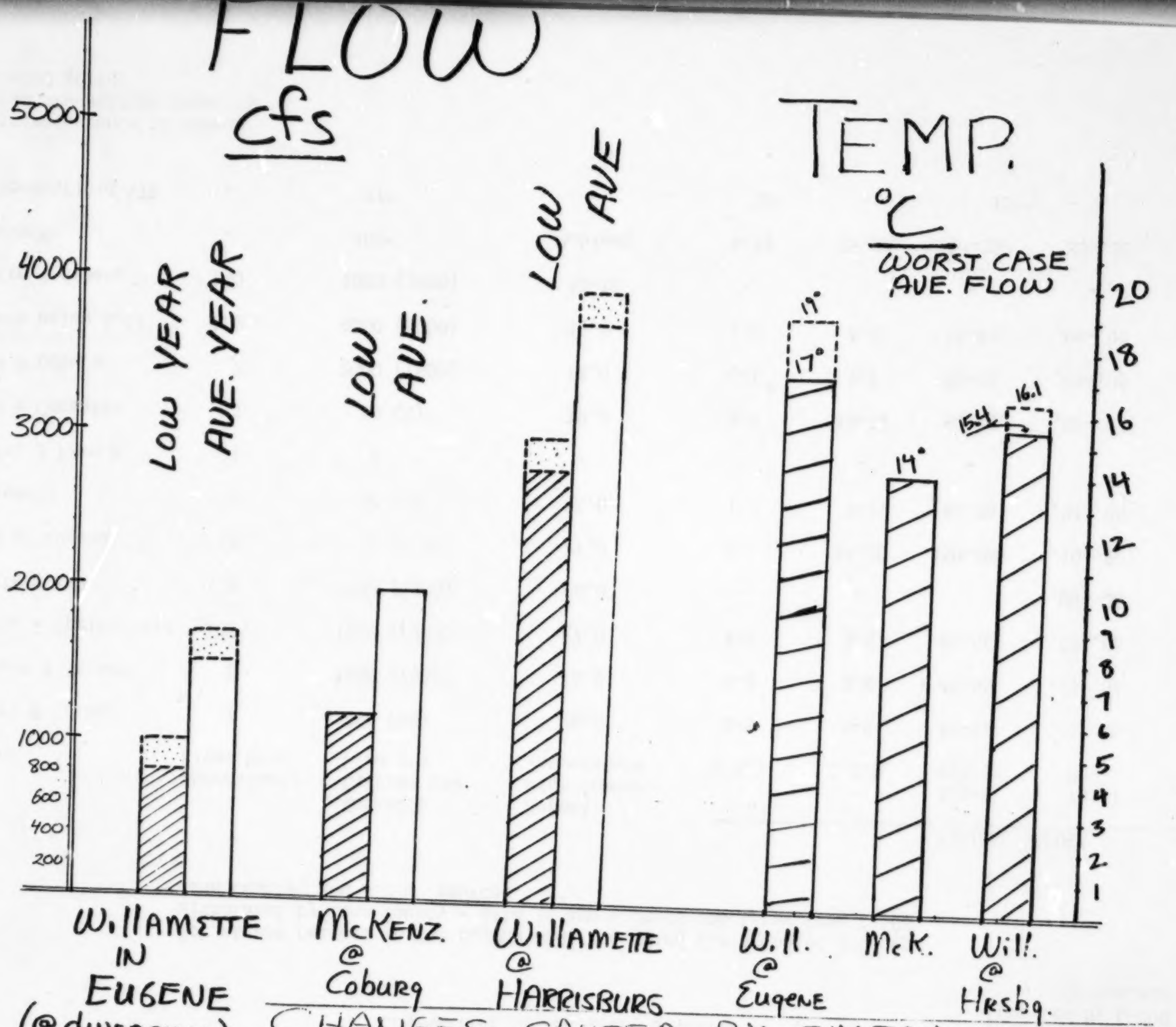
COMPARATIVE SUMMER WATER QUALITY

July 3, 1980
Compiled by L-COG
208 Program

For stream reaches in the Eugene area regarding the proposed 200 cfs withdrawal by Lane County - data is approximate and taken from L-COG Lane County, and D.E.Q. sources.

River	Approximate River Mile	Normal & Extreme Low Flow cfs	Normal High Summer Temperature	TYPICAL VALUES				
				B.O.D.	C.O.D.	Total Solids	Total POy	Fec. Colif
Coast Fork @ Goshen	7	250 (50)	20.0	2-3	3-6	45-55	.05-.06	50
Middle Fork @ Jasper	8	1500 (750)	16.5	0-2	3-5	45-55	.03-.04	5
Willamette @ Springfield	185	1700 (1200)	17.0	1-2	3-5	45-55	.04-.05	100
Willamette @ STP	178	1700 (1200)	18.0	-	-	-	.05-.06	-
Amazon @ W. Eugene	15	5 (0.5)	21.0	2-3	15-20	150-200	.10-.20	650
Long @ Veneta	31	10 (5)	16.0	1-3	7-11	60-70	.04-.05	300
Coyote Cr. @ Fern R.	1	0	-	-	-	-	-	-
Long Tom @ Cheshire	20	50 (5)	19.0	3-5	10-14	60-70	.06-.07	50
McKenzie @ Coburg	7	2000 (1500)	14.0	0-1	2-5	45-55	.04-.06	5
Willamette below Noti	170	4000 (3000)	15.5	1-2	4-8	50-60	.05-.07	20
Willamette @ Albany	140	4500 (3000)	18-19	-	-	-	-	-
Urban Runoff	-	200*	Ambient	5-15	25-60	200-300	.20-.30	3500
Eugene/Springfield STP	-	77*	-	10	-	10**	-	-

* 1 year recurrence in summer
** Maximum dry weather capacity
** Suspended solids



CHANGES CAUSED BY EMERALD CANAL

LCOG
Lane Council of Governments
NORTH PLAZA LEVEL PSB / 125 EIGHTH AVENUE EAST / EUGENE, OREGON 97401 / TELEPHONE (503) 687-4283

MEMORANDUM

December 31, 1980

TO: 208 AAC

FROM: 208 Staff

SUBJECT: URBAN RUNOFF CRITICAL AREAS

One of the objectives of the Urban Runoff programs is to designate areas where water quality is of special concern. The program is then determining what water quality problems exist and what beneficial uses are affected. Ultimately water quaity protection plans should result for critical areas.

At the January meeting we will go over water quality problems at areas of concern and the uses that are affected. The initial critical areas believed to carry the brunt of urban runoff pollution are listed below:

Area	Beneficial Uses
Springfield Millrace below 5th St.	Aesthetics Development Enhancement
Willamette River at Island Park and Island Park Slough	Aesthetics Water non-contact recreation Water contact recreation (swimming, boating, wading, fishing) Fish and Wildlife habitat
Alton Baker Ponds	Aesthetics Non-contact recreation Water Quality Enhancement (Non-designated but occassional use for contact recreation)
Q St. Channel from I-5 to Alton Baker Pond	Wildlife habitat. Water Quality Enhancement Drainage/Flood Control

LCOG MEMBER AGENCIES: City of Coburg • City of Cottage Grove • City of Creswell • Dunes City • City of Eugene • Eugene Water & Electric Board • City of Florence • Junction City • Lane Community College • Lane County • Lane Intermediate Education District • City of Lowell • North Lane Soil & Water Conservation District • City of Oakridge • Port of Siuslaw • Rainbow Water District • River Road Park & Recreation District • School District 52 (Bethel) • School District 4J (Eugene) • School District 19 (Springfield) • City of Springfield • Springfield Utility Board • Upper Willamette Soil & Water Conservation District • City of Veneta • Willamalane Park & Recreation District. CITIZENS' AND TECHNICAL ADVISORY COMMITTEES: Aging • Criminal Justice • Economic Development • Housing • Human Resources • Land Use • Transportation • Water Quality.

Area	Beneficial Uses
Amazon Channel through Amazon Park	Aesthetics Wildlife habitat Non-contact Recreation (bike path and walkway) Water Quality Enhancement (non-designated but occassional use for contact recreation) Education Drainage/flood control
Amazon Channel from Garfield to Quaker	Non-contact Recreation (bike and walkway) Development Enhancement Wildlife habitat Water Quality Enhancement Drainage (non-designated but occassional use for contact recreation)
Amazon Channel from Willow Creek to Fern Ridge	Fish and wildlife habitat Water quality enhancement Drainage/flood control Irrigation Water contact recreation (limited fishing, hunting and boating)
Bertelsen Marsh (A-3 Channel from Wallis St. to Bertelsen)	Wildlife habitat Water quality enhancement Aesthetics
Willamette River S. Bank below Polk Stormsewer Outfall at Valley River footbridge	Aesthetics Fish and Wildlife habitat Limited water contact Recreation - boating, fishing
Eugene Millrace University area to Ferry Street terminus	Aesthetics Duck habitat and feeding Canoeing College pranks

Other significant metropolitan waterways which may now or in the future be impacted by urban runoff are:

Cedar Creek - Thurston area of Springfield
Borrow pond and adjacent wetlands at the I-105/42nd St. exit in Springfield
McKenzie River - Hayden Bridge Road and North Springfield Area

Willamette River - Forks to confluence w/McKenzie - Greenway impacts
Springfield Mill Race near origin
Coast Fork Willamette Sloughs - from 30th Avenue LCC Area
Amazon Creek through E-W Amazon corridor
Delta Ponds
Willakenzie/Cal Young, North Eugene Drainage System
Golden Garden Ponds - A-2 Channel
Clear Lake - "old" Amazon Creek
Fern Ridge Reservoir
Willow Creek

Action Requested:

Committee recommend areas to concentrate on, prioritize uses and comment on specific problems at the various sites.

BK:db

NURP PROBLEM ASSESSMENTS

Critical Area Designation - 208 AAC

At their regular meeting on February 4, 1981, the L-COG 208 Advisory Committee reviewed information prepared by the 208 staff on all 27 local urban waterways, their general characteristics, land use quality problems and beneficial uses and pollution impacts. Several of the AAC members had participated in a field trip on February 1. A slide presentation on local waterway uses, problems and physical aspects was also shown at the February meeting. Staff request to the AAC was to consider the information and designate, if possible, up to a dozen areas of "major concern" or as "critical areas".

The advisory committee found it very difficult to designate critical areas without more specific criteria from 208 staff or EPA as to their future use in planning and funding. L-COG staff had originally recommended several critical areas on "urban feeder" channels as well as "urban tributary" waters. The committee preferred not to go through the information drainage by drainage but rather to designate major widely recognized tributary areas which are impacted by the most significant urban feeders in order to focus initial urban runoff efforts.

The result of those criteria were the designation of Fern Ridge Reservior (impacted by the upper Amazon and Amazon diversion channel) and Alton Baker Ponds (impacted by the "Q" Street channel system). Staff and some committee members were concerned that three highly polluted smaller systems impacting a unique urban marsh, the Willamette Greenway, and another popular day use park were omitted by this analysis. The committee debated whether designating five areas would decrease the probability of solving any problems. After discussion, two areas; Bertlesen Slough-wildlife area (impacted by A-3 ditch) and Island Park (impacted by the Springfield Mill Race) were added to make four areas of highest priority concern for urban runoff impacts. The fifth area, the Willamette River South Bank impacted by the Polk Street Stormsewer was not included because the associated beneficial uses were not as tangible.

Critical problem source areas were also designated in association with the four impact areas of highest priority concern. These problem source areas are considered to be the location where treatment needs and BMP's are most crucial. They are listed in the following Table 1:

160

TABLE I Eugene-Springfield Urban Runoff Critical Impact Areas and Major Pollution Sources

Critical Area	Problem Source
Alton Baker Ponds	- South Branch "Q" Street Channel
	- Downtown Springfield
	- North Springfield Interceptor By-Pass
Fern Ridge Reservoir	- West 11th Commercial/Industrial Area
	- Downtown Eugene (southern portion)
Bertlesen Slough	- 5th Avenue Stormsewer (Industrial Area)
	- 7th Avenue Stormsewer (Industrial Area)
Island Park	- 2 Downtown Springfield Commercial/Industrial Stormsewers with outfalls to the Millrace

Secondary priority areas were mentioned but were not designated because of a concern for dilution of specific program efforts. The Committee felt it should not be attempted unless there was a clear purpose for each designation.

There was a strong suspicion that several of the worst water quality situations are caused by illegal commercial and industrial point sources (albeit small ones) and that strengthened enforcement of existing regulations and water quality standards would go a long way toward cleaning up other urban drainages. Staff and some committee members tried to illustrate that even if this assumption were true the enforcement envisioned would require a major funding program. The AAC requested that staff keep them informed on DEQ and NURP policy and on the local state and federal potentials for specific cleanup projects.

BK:GR:ml/db

APPENDIX H

MANAGEMENT PROGRAM

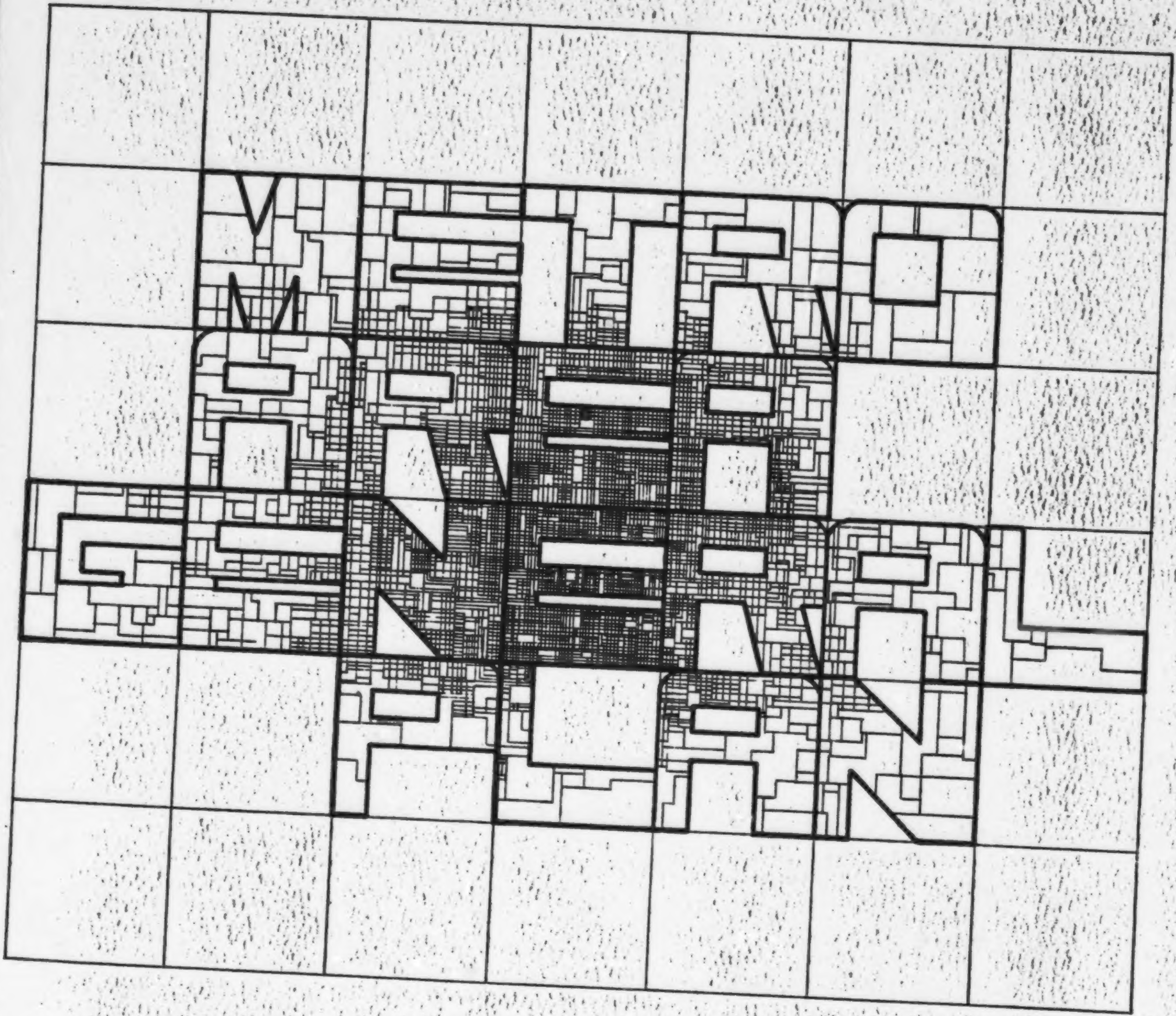
CONTENTS

Metro Area General Plan Excerpts

Springfield Chapter X Land Division and Development

Urban Runoff Program Recommendations

400



Eugene, Springfield, & Lane County
AUGUST, 1980

C. Environmental Resources Element

The Environmental Resources Element deals with the natural assets and hazards of the metropolitan area. The assets include agricultural land, clean air and water, forest land, sand and gravel deposits, scenic areas, vegetation, wildlife, and wildlife habitat. The hazards include problems associated with floods, soils and geology. The emphasis of the policies is directed toward reducing urban impacts on wetlands throughout the metropolitan area and toward planning for the natural assets and constraints on undeveloped lands on the urban fringe.

Numerous local efforts reflect a positive attitude by the community toward the natural environment. For example, the Eugene-Springfield metropolitan area has a long history of commitment to local programs directed toward problems of air and water quality. Examples of regional parks which provide significant public open space areas for the metropolitan population include Eugene's Skinner's Butte, Spencer Butte and Hendricks; Lane County's Alton Baker, Clearwater and Howard Buford Recreation Area (Mt. Pisgah); and Willamalane Park and Recreation District's Dorris. Eugene has focused special planning efforts toward controlling development and maintaining the scenic and environmental assets in the south hills of the city. A tax levy passed by Eugene voters is resulting in additions to the park and open space system in the metropolitan area. Lane County, Springfield, and Eugene all contribute to the local success of the Willamette River Greenway Program.

The natural environment adds to the livability of the metropolitan area. Local awareness and appreciation for nature and the need to provide a physically and psychologically healthy urban environment are reasons for promoting a compatible mix of nature and city. Urban areas provide a diversity of economic, social, and cultural opportunities. It is equally important to provide diversity in the natural environment of the city. With proper planning, it is possible to allow intense urban development on suitable land and still retain valuable islands and corridors of open space. Open space may reflect a sensitive natural area, such as the floodway fringe, which is protected from development. Open space can also be a park, a golf course, a cemetery, a body of water, or an area left undeveloped within a private commercial or residential development. Agricultural and forested lands on the fringe of the urban area, in addition to their primary use, provide secondary scenic and open space values.

Air and water resources are especially vital in an urban area. Internal and external factors contribute to problems associated with air quality and water quality and quantity, but techniques are available to help reduce these problems and make the environment more livable.

The compact urban growth form concentrates urban development and activities, thus protecting valuable resource lands on the urban fringe. But concentrating development increases pressures for development within the urban growth boundary, making planning for open space and resource protection a critical concern within that boundary. Planning can ensure the coexistence of city and nature; one example is the Willamette River Greenway.

The Environmental Resources Element provides broad direction for maintaining and improving our natural urban environment. Other elements dealing in more detail with particular aspects of the natural environment include Parks and Recreation Facilities and Environmental Design (scenic). With particular respect to waterways, the emphasis in this element is on their protection as a valuable and irreplaceable component of the overall natural resource system important to the metropolitan area. Waterways are also the subject of Section D, the Willamette River Greenway, River Corridors, and Waterways. While some repetition is unavoidable, in that section the emphasis is on their intrinsic value for enjoyment, active and passive use by residents of the area.

The inventories conducted as the basis for this element and the goals, objectives, and policies contained herein address numerous statewide planning goals and interpret those goals in the context of the needs and circumstances of the metropolitan area.

Findings

1. The high value placed on clean air and water by local residents is reflected in local commitments to plans and programs directed toward reducing air and water pollution.

2. The potential for air pollution in the Upper Willamette Valley is considerable due to prevailing winds, to surrounding mountains which trap the air, and to the natural conditions caused by temperature inversions.

3. Some pollutants affecting metropolitan air and water quality originate outside the metropolitan area.

4. The metropolitan area violates state and federal air quality standards for suspended particulates (solid and liquid particles of soot, dust, aerosols and fumes), carbon monoxide (a colorless, odorless toxic gas mostly resulting from incomplete combustion from automobile engines), and state standards for ozone (odorless, toxic gasses produced by reaction between oxides of nitrogen and hydrocarbons in the presence of sunlight). Suspended particulates represent the most severe air quality problem facing the metropolitan area.

5. Existing suspended particulate air quality standards and monitoring techniques, which are based on weight, do not adequately account for air pollution impacts of the finer particulates. Recent

evidence indicates fine particulates have a greater potential for adverse effects on human health than do larger particulates.

6. The Eugene-Springfield Air Quality Maintenance Area Citizens' Advisory Committee for Total Suspended Particulates is scheduled to complete control strategies for attainment of the Oregon suspended particulate air quality standards by July, 1980. Local governments, in cooperation with state agencies, are conducting an analysis of the carbon monoxide problem in the metropolitan area. Preliminary results indicate that additional control strategies will be necessary if carbon monoxide air quality standards are going to be met by December, 1982 as required. Such strategies will be evaluated by July, 1980.

⑦ Reduction of open space, removal of vegetative cover, and development which increases the amount of impervious surfaces (for example, paved streets, roofs, parking lots) contribute significantly to increases in the peak volume (quantity) of urban storm runoff entering storm sewers and natural drainage ways.

⑧ Water pollution in the metropolitan area results from both "point sources" (municipal and industrial wastewater discharges) and "nonpoint sources" (pollutants such as oil, dust and debris which are carried into streams by storm runof). Water pollution is most acute in streams which have low water flow conditions during the summer months (such streams include Amazon Creek and the "Q" Street ditch).

⑨ Offsetting measures can reduce the negative effects of urban development on water quality and quantity problems. Examples include on-site retention of storm water, inclusion of landscaped "buffer strips" adjacent to new developments and conservation and improvement of streamside vegetaton along water courses.

10. Total land designated and zoned for sand and gravel extraction in the metropolitan area and immediately adjacent subareas appears adequate for demand through the planning period.

11. Sand and gravel deposits are an important natural resource necessary for construction in the metropolitan area. Nevertheless, the extraction of sand and gravel can conflict with other open space and recreation values associated with water resources, vegetation, wildlife habitat and scenic quality. Proper rehabilitation and reuse of abandoned sand and gravel sites can result, however, in the return of valuable land for urban uses, including open space.

12. Due to the general nature of soils and geologic mapping, site specific analysis is often necessary to determine the presence of

geologic hazards and the severity of soil problems which are constraints to development. Such geologic hazards exist when certain combinations of slope, soil conditions, and moisture conditions render land unstable.

13. The statewide agricultural goal definition is based upon the U.S. Soil Conservation Service's Soil Capability Classification System. The majority of land in the metropolitan area is located on agricultural soils rated Classes I through IV and much of this area has already experienced urban development. The hillside soils are generally included in nonagricultural rated Classes V through VIII.

14. Commercial forest lands within the metropolitan area are generally located in rural areas south of Eugene and Springfield with the largest concentration located southeast of Springfield.

15. The Willamette and McKenzie Rivers run through many jurisdictions, necessitating cooperative water management planning and consideration for downstream effects of actions taken by a single jurisdiction.

16. Unless special precautions are taken, development within the floodway fringe (that portion of the flood plain having a one percent per year chance of occurrence - also known as a 100 year flood) is subject to hazards to life and property from flooding.

17. Many portions of the floodway fringe contain natural assets such as significant vegetation, wildlife and scenic areas and productive agricultural lands and are thus valuable for open space and recreation. On the other hand, because of their central location, some floodway fringe areas within the urban service area are important lands for urban development.

18. While development and in-filling have decreased the amount of open space (and associated vegetation and wildlife habitat) within the urban service area, the compact urban growth form has protected open space on the urban fringe and in rural areas within the metropolitan area.

19. Compact urban growth results in pressure on open space within the current urban service area. Programs for preserving quality open space within the projected urban service area become more important as the area grows.

20. Inventories of vegetation, wildlife, and wildlife habitats resulted in the identification of significant areas. Water, wetlands and areas of diverse vegetation are the most productive wildlife habitats within the metropolitan area. Over half of the significant vegetation and wildlife areas identified in the inventories are already in public ownership.

(21.) Open space provides many benefits in an urban area including: retention of habitat for wildlife, filtration of polluted water, absorption of storm runoff flow, protection of scenic quality, provision of recreation opportunities, reduction of atmospheric temperatures, and personal well-being.

22. Literature search and interviews with specialists resulted in the identification of endangered and threatened (as recognized on existing and proposed state and federal lists) plant and wildlife species whose normal or historic range includes the metropolitan area. Without additional comprehensive field studies (including field work), it is not possible to determine the actual existence and location of many of those species.

23. Urban agriculture, in other words, backyard and community gardens, and interim use of vacant and underdeveloped parcels, provides economic, social, and environmental benefits to the community.

24. Where urban and agricultural lands abut, farm use management problems are frequently created.

Goals

(1.) Protect valuable natural resources and encourage their wise management, proper use, and reuse, reflecting their special natural assets.

2. Maintain a variety of open spaces within and on the fringe of the developing area.

3. Protect life and property from the effects of natural hazards.

4. Provide a healthy and attractive environment for the metropolitan population.

Objectives

(1.) Maintain the benefits associated with environmental resources in an urban setting. Those resources include agricultural lands, clean air and water, forest lands, sand and gravel deposits, scenic areas, wildlife and wildlife habitat, and vegetation. Policies directed toward these resources may differ depending upon whether they are located on urban, rural, or urbanizable land.

2. Maintain the livability of the metropolitan area by integrating open spaces and urban development by planning for a variety of public and private open spaces, and by considering the natural environment when making planning decisions.

3. Improve and maintain air and water quality to meet acceptable state and local standards.

4. Minimize problems associated with water quantity.

5. Manage open space areas for their diverse and multiple values.

6. Prevent damage to life and property and expenses associated with flooding and problem soils.

7. Minimize the impacts of urban development on agricultural land and other valuable open space by promoting compact urban growth and by using urban land efficiently (e.g., increasing urban densities).

8. Protect nonrenewable (sand and gravel) resource lands from premature urban development, thus allowing for extraction and production of that resource.

Policies

1. Springfield, Lane County, and Eugene shall consider downstream impacts when planning for urbanization, flood control, urban storm runoff, recreation, and water quality along with Willamette and McKenzie Rivers.

2. Development shall be prohibited within the floodway. The floodway is the portion of the flood plain where high volumes of moving water flow through drainways or channels of a watercourse.

3. When development is allowed to occur in the floodway fringe, local regulations shall control such development in order to minimize the potential danger to life and property. Within the urban service area, development should result in in-filling of partially developed land. Outside the urban service area, the floodway fringe should be protected for its agricultural and sand and gravel resource values, its open space and recreational potential, and its value to water resources.

4. Local governments shall require site specific soil surveys and geologic studies where potential problems exist. When problems are identified, local governments shall require special design considerations and construction measures be taken to offset the soil and geologic constraints present, to protect life and property, and to protect environmentally sensitive areas.

5. Where agricultural land is being considered for inclusion in the urban growth boundary, the least productive agricultural land shall be considered first. Factors other than agricultural soil ratings shall be considered when determining the productivity of agricultural land. Relevant factors include ownership patterns, land use patterns, adjacent land uses, agricultural history, availability of irrigation, and market availability.

6. Agricultural production shall be considered an appropriate interim and temporary use on urbanizable land and on vacant and underdeveloped urban land.

7. Continued local programs supporting community gardens on public land and programs promoting urban agriculture on private land shall be encouraged. Urban agriculture includes gardens in backyards and interim use of vacant and underdeveloped parcels.

8. Sand and gravel resource areas shall be protected from premature urban development in order to maintain existing and future sources of this important, nonrenewable resource in close proximity to the metropolitan market. The relationship between the demand for the resource and the amount of land planned and zoned for sand and gravel extraction and processing should be closely monitored, so as to ensure the future availablity of aggregate material.

9. Local governments shall continue, through land use planning and special regulations, to control sand and gravel extraction and production in order to:

   a. Minimize negative effects on surrounding land uses and on other natural resources;

   b. Require reclamation plans for extraction and processing areas which encourage re-use of such lands in a manner compatible with adjacent land uses and adopted plans in accordance with State law.

   c. Allow other appropriate uses such as agricultural production, timber production, parks and other open space uses.

10. Lane County shall conduct studies to determine:

    a. The location, quality, and quantity of sand and gravel resources within the resource areas designated in the technical supplement.

    b. Conduct reanalysis of the relationship between the demand for the resource and the land planned, zoned, and actually usable for extraction.

    These studies should be conducted in cooperation with local sand and gravel industries.

⑪ Metropolitan goals relating to scenic quality, water quality, vegetation and wildlife, open space, and recreational potential shall be given a higher priority than timber harvest within the urban growth boundary.

12. When evaluating the desirability of harvesting commercial timber on forest lands within the jurisdictional boundary but outside the urban growth boundary, great emphasis shall be placed on preserving scenic and water quality, as well as protection of wildlife, open space, and recreational potential.

13. Lane County shall support programs (state laws, for example) which benefit small woodlot management in rural areas.

14. Local governments shall develop plans and programs which carefully manage development on hillsides and in water bodies and restrict development in wetlands in order to protect the scenic quality, water quality, vegetation and wildlife values of those areas.

15. In order to improve water quality and quantity in the metropolitan area, local governments shall consider developing regulations or instituting programs to:

   a. Increase public awareness of techniques and practices private individuals can employ to help correct water quality and quantity problems;

   b. Improve management of industrial and commercial operations to reduce negative water quality and quantity impacts;

   c. Regulate site planning for new development and construction to better control drainage and erosion and to manage storm runoff;

   d. Increase storage and retention of storm runoff to lower and delay peak storm flows;

   e. Utilize natural and simple mechanical treatment systems to provide treatment for contaminated runoff waters;

   f. Reduce street-related water quality and quantity problems; and

   g. Minimize use of toxic substances.

16. Local governments shall continue to cooperate in developing and implementing ongoing plans and programs necessary to address control strategies adopted for meeting suspended particulate, carbon monoxide, and ozone air quality standards.

17. Local governments shall encourage changes to state and federal air quality regulations relating to development of fine particulate standards and related monitoring techniques.

18. When planning for and regulating development, local governments shall each continue to consider the need for protection of open spaces, including those characterized by significant vegetation and wildlife. Means of protecting open space include, but are

not limited to, outright acquisition, conservation easements, planned unit development ordinances, streamside protection ordinances, open space tax deferrals, donations to the public, and performance zoning.

19. Eugene shall maintain and improve and Springfield shall adopt hillside development regulations.

20. Local governments shall encourage further study by specialists of endangered and threatened plant and wildlife species in the metropolitan area.

21. Local governments shall take steps to protect endangered and threatened plant and wildlife species as recognized on a statewide list.

22. The Plan diagram's intent is to include existing sand and gravel zoned areas in sand and gravel designation.

23. Local governments shall develop policies and local controls for protection and management of wetland areas. *

24. Local jurisdictions should work with owners of designated environmentally sensitive areas to encourage that reasonable actions are taken to preserve these lands, e.g., the heronry at the confluence of the Willamette and McKenzie rivers and the site of the *Aster curtis* in the Willow Creek basin.

D. Willamette River Greenway, River Corridors, and Waterway Element

The Willamette River has long been recognized in the Eugene-Springfield area as a valuable natural asset. A number of policy documents and programs adopted by local jurisdictions have reinforced the community concern to preserve and protect metropolitan river corridors.

On December 6, 1975, the Land Conservation and Development Commission adopted Statewide Planning Goal 15, Willamette River Greenway. The goal sets forth the overall framework within which state and local governments carry out protection and maintenance of the Willamette River Greenway.

The goal requires Eugene, Springfield, and Lane County to adopt Greenway boundaries, to specify uses permitted within those boundaries, and indicate areas of potential acquisition along the Greenway. In making these determinations, local jurisdictions must gather information and inventory the nature and extent of all natural resources associated with the Willamette River Greenway. Local jurisdictions are also mandated to adopt provisions by ordinance requiring a compatibility review permit for any intensification, change of use, or development within Greenway boundaries. The cities of Eugene and Springfield have received final Greenway boundary approval by the Land Conservation and Development Commission for that portion of the Greenway located within their city limits. Lane County has adopted interim Greenway boundaries that will be in effect until final Greenway boundary adoption.

Eugene received LCDC acknowledgement of compliance with Goal 15 on February 11, 1977. Springfield and Lane County are both undertaking the work required to comply with Goal 15, which is scheduled to be completed by July 1980.

In the metropolitan area, a large portion of land within the Greenway is in public ownership and existing public parks such as Mount Pisgah, Skinner's Butte, Alton Baker, and Island Park. Future proposed park acquisitions such as the Goodpasture Island gravel ponds will further expand the opportunity for public access and enjoyment of the river area. The three jurisdictions have also cooperated in the development of a bicycle-pedestrian trail system that extends along the Greenway from south of Springfield to north of Eugene and into the River Road area. This system includes three bike bridges across the river.

Land along the Greenway in private ownership is in a variety of uses, some of which appear to provide greater opportunity than others for public access and enjoyment. Residential uses along the Greenway can provide the residents with access to the river area. Certain commercial uses such as restaurants can allow customers visual enjoyment of the Greenway. Other uses such as the many industrial uses would appear to provide little if any opportunity for access or enjoyment of the Greenway. This is evidenced by much of the existing industrial development along the Willamette River in the Glenwood area. Finally, in rural agricultural areas, isolated access points can work to the detriment of the Greenway program. In these areas, trespass and vandalism can cause a detraction in the general Greenway environment and create problems for private landowners.

Due to the metropolitan scale and general nature of this Plan, it is not possible to accurately depict the Greenway boundary, to show all allowed uses within the boundary in a completely site specific fashion, or to show areas of future public acquisition. The Greenway boundaries, as adopted by the three jurisdictions, are shown in a form as accurate as possible on the auxiliary map accompanying the Plan diagram. Specific boundary designations, future acquisition areas and uses allowed within the Greenway remain the primary responsibility of the local jurisdictions. This element, however, provides the basis for a coordinated effort by Eugene, Springfield, and Lane County.

The Statewide Greenway goal specifically applies to the Willamette River. In the Eugene-Springfield area, portions of the McKenzie River share equal importance as a natural resource worthy of conservation and protection. Additionally, the metropolitan network of waterways and associated creeks and drainageways are important features in the metropolitan area with potential as part of an areawide waterways system. For that reason, while this element must specifically cover the Willamette River Greenway, it is important to consider the McKenzie River, where it is situated within the area of the Plan and the inland system of waterway corridors connecting various parts of Springfield, Eugene, and Lane County to one another.

Findings

1. The Willamette and McKenzie Rivers are recognized as valuable natural assets to the entire community.

2. In addition to the Willamette and McKenzie Rivers, a number of waterways are important environmental features in the metropolitan area. These include, for example, the Springfield Millrace, Amazon Creek, Fern Ridge Reservoir, and the Eugene Millrace.

3. Recently, the community has begun to realize the potential of inland waterway corridors to contribute to the livability of the area.

4. In addition to its significance to agriculture, flood control, and fish and wildlife, Fern Ridge Reservoir continues to grow in importance as a recreational water facility.

5. Statewide Planning Goal 15, Willamette River Greenway, mandates local governments to establish the Greenway boundaries, allowed uses within the Greenway and potential acquisition areas.

6. Eugene and Springfield have received final Greenway boundary approval by the Land Conservation and Development Commission.

7. The City of Eugene received Land Conservation and Development Commission acknowledgment of compliance with Statewide Planning Goal 15 on February 11, 1977. Lane County and Springfield are both undertaking the work to comply with Goal 15.

8. Compatibility Review Permits are required by Eugene, Springfield, and Lane County for any intensification, change of use or new development within the Greenway boundaries.

9. Local juridictions retain the primary reponsibility for implementation of the Willamette River Greenway goal.

10. The metropolitan area's river and waterway corridors require protection to maintain and enhance natural, scenic, environmental, and economic qualities of these waterways.

11. The three jurisdictions have cooperatively developed a public park system and bicycle-pedestrian trails along the Willamette River Greenway.

12. Residential and commercial development along the Willamette River Greenway provides greater opportunity for public access and enjoyment of the river area than does industrial development.

13. Rural agricultural areas along river and waterway corridors can be damaged by isolated public access points because of vandalism and/or trespass on private lands.

14. Experience in other communities indicates that carefully planned and designed residential and commercial development at designated locations along inland water corridors can be compatible with adjacent areas and the corridors themselves.

15. The current unpleasant and unsightly condition of many inland waterway systems results from neglect and uncoordinated waterway planning.

Goal

Protect, conserve, and enhance the natural, scenic, environmental and economic qualities of river and waterway corridors.

Objectives

1. Encourage use of river and waterway corridors to fulfill open space, recreation, and resource protection needs.
2. Ensure than development occurring within river and waterway corridors is responsive to and provides protection of these valuable natural assets.
3. Encourage, where appropriate and in keeping with Greenway goals, development that respects the quality of rivers and waterways, and provides a variety of opportunities for enjoyment of those resources by the public.
4. Encourage coordinated water planning and the development of the area's waterways, where appropriate as part of the area's open space and park system.

Policies

1. Periodically, local governments shall review Greenway boundaries, uses, and potential acquisition areas to ensure continued compliance with state and local Greenway goals.
2. Land use regulations and acquisition programs along river corridors and waterways shall take into account all the concerns and needs of the community including recreation, resource, and wildlife protection, enhancement of river corridor and waterway environments, potential for supporting nonautomobile transportation, opportunities for residential development, and other compatible uses.
3. Eugene, Springfield, and Lane County shall continue to cooperate in expanding water related parks and other facilities, where appropriate, that allow access to and enjoyment of river and waterway corridors.
4. Lane County, Springfield, and Eugene shall continue to participate in efforts to determine the feasibility of an urban canal that would connect Eugene's historic Millrace to Amazon Creek. Likewise, Springfield's efforts to improve the scenic quality of its Millrace should be encouraged.
5. New development that locates along river corridors and waterways shall be limited to uses that are compatible with the natural, scenic, and environmental qualities of those water features.
6. New industrial development that locates along the Willamette and McKenzie Rivers shall enhance natural, scenic, and environmental qualities.

7. Potential public access points in rural agricultural areas shall be carefully reviewed to ensure preservation of the Willamette River Greenway environment with special emphasis on problems of vandalism and trespass.

8. Within the framework of mandatory statewide planning goals, local Willamette River Greenway plans shall allow a variety of means for public enjoyment of the river, including public acquisition areas, residential areas, and commercial areas.

E. Environmental Design Element

The Environmental Design Element is concerned with that broad process which molds the various components of the urban area into a distinctive livable form that promotes a high quality of life.

The Metropolitan General Plan must go beyond making the urban area more efficient and better organized to also ensure that the area is a pleasant, attractive, and desirable place for people to live, work, and play. The Environmental Design Element is concerned with how people perceive and interact with their surroundings. Perceptions of livability greatly differ between individuals, so generalizations concerning this element need to be carefully drawn. Many different indicators of livability have been identified, such as the numbers of local educational, medical, and recreational facilities, and natural environmental conditions. Not all these indicators are directly concerned with environmental design, showing that the concept of livability is influenced by all elements of the Metropolitan General Plan. This element focuses on some of the features of the natural and built environment that affect the quality of life.

The metropolitan area is changing in ways that are far-reaching and diverse. Decisions which concern change have an effect on the form of the area. If we are to maintain a livable urban environment and realize the full potential of our desirable and distinctive qualities, daily decisions that concern change must be guided by environmental design principles, such as site planning, in combination with other planning policies.

Based on concerns related to energy conservation, environmental preservation, transportation, and other issues, increased density is desirable. This increases the need for effective, detailed environmental design in order to ensure a high quality of life, and a high degree of livability in an increasingly dense urban environment.

This area is noted for the high degree of livability enjoyed by its residents. Environmental design is a process that helps to maintain and enhance these positive attributes.

Findings

1. Present and continued emphasis on compact growth increases the need for attention to detailed, specific environmental design components such as site planning and landscaping of development.
2. Decisions are constantly being made which affect the form and design of the metropolitan area.

3. The location and design of public and private facilities play an important role in giving distinctive identity and character to an area. For example, an area's character may be developed through association with a particular park, a land form, a public building, an area of older homes, vegetation, or a distinctive type of subdivision design.

4. Natural land features, waterways, and native vegetation provide distinctive and easily identifiable components to the metropolitan area environment.

5. The metropolitan area presently offers a variety of naturally distinctive topographic features, waterways, and vegetation that are both visually and personally accessible to residents.

6. Ridgelines and water areas provide the greatest concentration of scenic sites in the metropolitan area.

7. Landscaping with trees and other vegetation provides a pleasant, distinctive, and permanent atmosphere for the metropolitan area.

8. The use of buffer strips and other design features can minimize the negative environmental impact of certain uses, such as roadways and parking areas, while protecting adjacent land uses.

9. Local residents are concerned about the livability and aesthetic quality of residential development that changes the character of their neighborhoods.

Goals

1. Secure a safe, clean, and comfortable environment which is satisfying to the mind and senses.

2. Encourage the development of the natural, social, and economic environment in a manner that is harmonious with our natural setting and maintains and enhances our quality of life.

3. Create and preserve desirable and distinctive qualities in local and neighborhood areas.

Objectives

1. Provide the facilities and services needed to maintain our quality of life. Examples include educational, housing, medical, public transportation, and recreational facilities.

2. Encourage a greater diversity of living experiences and environments.

3. Establish or maintain a sense of identity and character for local and neighborhood areas.

4. Shape development to suit natural conditions as much as possible.

5. Enhance views and public use of river corridors, drainageways, and prominent topographic features such as ridgelines and buttes, within the jurisdiction of the Metropolitan Plan, when consistent with other planning policies.

Policies

1. In order to promote the greatest possible degree of diversity, a broad variety of commercial, residential, and recreational land uses shall be encouraged when consistent with other planning policies.

2. The utilization and retention of natural vegetation, natural water features, drainageways and landscaping shall be strongly encouraged as part of all urban developments.

3. The planting of street trees shall be encouraged.

4. Public and private facilities shall be designed and located in a manner that preserves and enhances desirable features of local and neighborhood areas and promotes their sense of identity.

5. Carefully develop sites that provide visual diversity to the urban area and optimize their visual and personal accessibility to residents.

6. Local jurisdictions shall carefully evaluate their development regulations to ensure that they adequately account for environmental design considerations, such as, but not limited to, site planning and landscaping of developments.

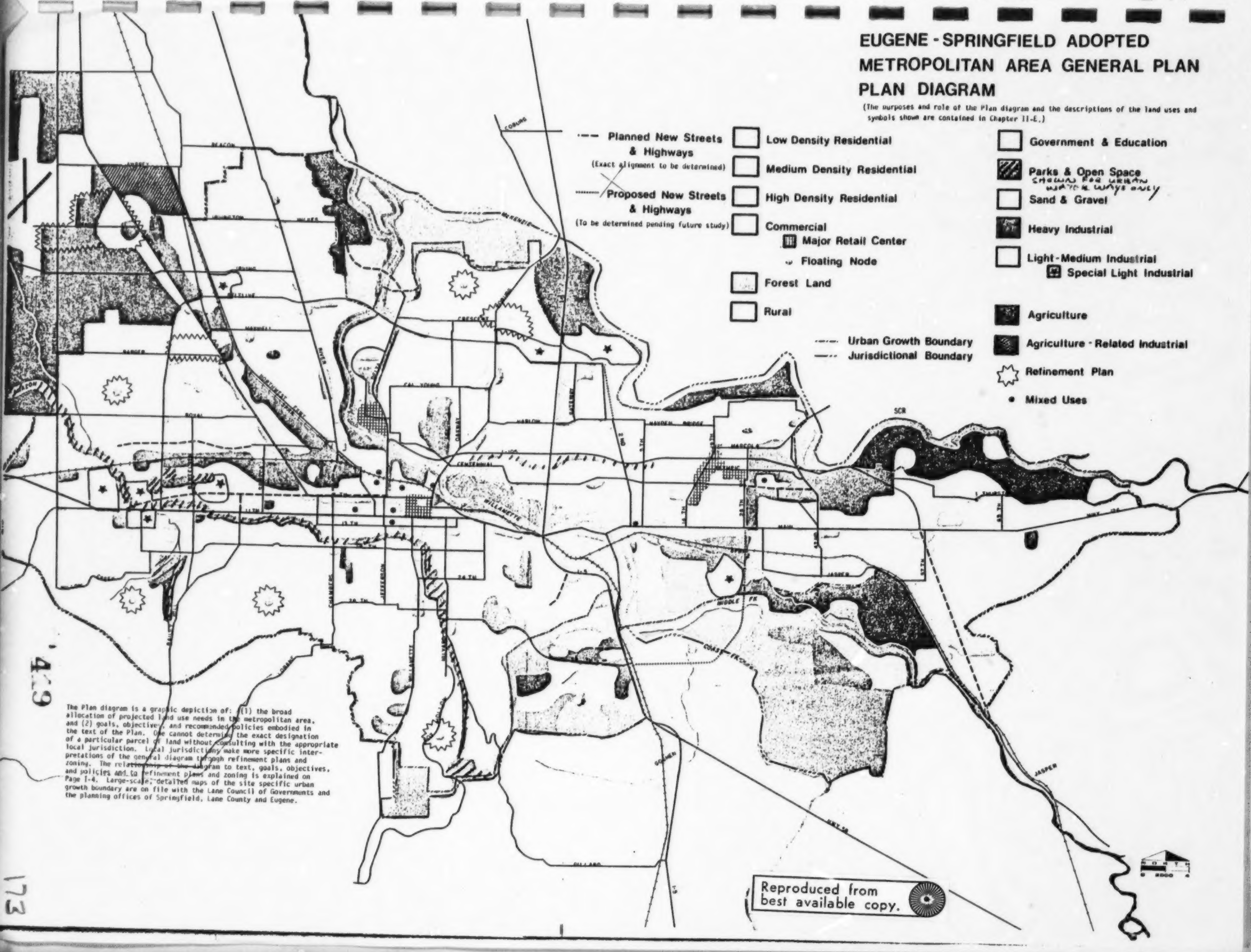
7. The development of urban design elements as part of local and refinement plans shall be encouraged.

8. Local governments should consider developing design standards to ensure compatibility with existing development and the livability of major medium and high density residential developments when located in areas otherwise characterized by lower density.

EUGENE - SPRINGFIELD ADOPTED METROPOLITAN AREA GENERAL PLAN

PLAN DIAGRAM

(The purposes and role of the Plan diagram and the descriptions of the land uses and symbols shown are contained in Chapter II-E.)



--- Planned New Streets & Highways
(Exact alignment to be determined)
~~......... Proposed New Streets & Highways~~
(To be determined pending future study)
☐ Low Density Residential
☐ Medium Density Residential
☐ High Density Residential
☐ Commercial
▦ Major Retail Center
● Floating Node
▨ Forest Land
☐ Rural
-·- Urban Growth Boundary
-- Jurisdictional Boundary
☐ Government & Education
▨ Parks & Open Space
SHOWN FOR URBAN WATER WAYS ONLY
☐ Sand & Gravel
■ Heavy Industrial
☐ Light-Medium Industrial
⊞ Special Light Industrial
■ Agriculture
▨ Agriculture - Related Industrial
✹ Refinement Plan
● Mixed Uses
COBURG
BEACON
CRESCENT
MAXWELL
BARGER
ROYAL
RIVER
CAL YOUNG
HARLOW
HAYDEN BRIDGE
MARCOLA
CENTENNIAL
WILLAMETTE
CHAMBERS
JEFFERSON
MAIN
JASPER
MIDDLE FK
COAST FK
SCR
GOSHEN
DILLARD

The Plan diagram is a graphic depiction of: (1) the broad allocation of projected land use needs in the metropolitan area, and (2) goals, objectives, and recommended policies embodied in the text of the Plan. One cannot determine the exact designation of a particular parcel of land without consulting with the appropriate local jurisdiction. Local jurisdictions make more specific interpretations of the general diagram through refinement plans and zoning. The relationship of the diagram to text, goals, objectives, and policies and to refinement plans and zoning is explained on Page I-4. Large-scale, detailed maps of the site specific urban growth boundary are on file with the Lane Council of Governments and the planning offices of Springfield, Lane County and Eugene.

Reproduced from best available copy.

Adopted Effective Date 1 July 81

CHAPTER X

LAND DIVISION AND LAND DEVELOPMENT

ARTICLE I. GENERAL
10-1-1 TITLE
10-1-2 PURPOSE AND INTENT
10-1-3 DEFINITIONS
10-1-4 SALE OF LOTS AND PARCELS AND CREATION OF STREETS
10-1-5 APPLICATION FEE
10-1-6 SUBDIVISION CHECKING FEE
10-1-7 STREET NAMING AND ADDRESSING
10-1-8 MAINTENANCE OF PRIVATE IMPROVEMENTS

ARTICLE 2. LAND DIVISION PROCEDURE
10-2-1 MAJOR AND MINOR PARTITION PROCEDURE
10-2-2 SUBDIVISION TENTATIVE PLAN PROCEDURE
10-2-3 SUBDIVISION PLAT PROCEDURE

ARTICLE 3. PLATTING STANDARDS
10-3-1 PLATTING STANDARDS - STREETS AND ROADS
10-3-2 PLATTING STANDARDS - ALLEYS
10-3-3 PLATTING STANDARDS - BLOCKS
10-3-4 PLATTING STANDARDS - LOTS AND PARCELS
10-3-5 PLATTING STANDARDS - RAILROADS
10-3-6 PLATTING STANDARDS - PARTIAL DEVELOPMENT

ARTICLE 4. DESIGN STANDARDS
10-4-1 DESIGN STANDARDS - GENERAL
10-4-2 DESIGN STANDARDS - LAND SURFACE DRAINAGE
10-4-3 DESIGN STANDARDS - STORM DRAINS
10-4-4 DESIGN STANDARDS - SANITARY SEWERS
10-4-5 DESIGN STANDARDS - PLANTING
10-4-6 DESIGN STANDARDS - UTILITIES
10-4-7 DESIGN STANDARDS - TELEVISION CABLE TRENCHING
10-4-8 DESIGN STANDARDS - STREETS AND ALLEYS
10-4-9 DESIGN STANDARDS - SIDEWALKS
10-4-10 DESIGN STANDARDS - SUBDIVISION PERIMETER STREETS
10-4-11 DESIGN STANDARDS - STREET LIGHTING
10-4-12 DESIGN STANDARDS - DRIVEWAYS
10-4-13 DESIGN STANDARDS - PEDESTRIAN PATHS AND BICYCLE FACILITIES
10-4-14 DESIGN STANDARDS - SIGNS
10-4-15 DESIGN STANDARDS - PRIVATE STREETS AND PARKING LOTS

ARTICLE 5. GRADING
10-5-1 GENERAL
10-5-2 PERMITS REQUIRED, EXCEPTIONS
10-5-3 ACTIONS PROHIBITED
10-5-4 HAZARDS
10-5-5 GRADING PERMIT CONDITIONS
10-5-6 PERMIT APPLICATION FORMS
10-5-7 REQUIRED INFORMATION FOR GRADING PLANS AND SPECIFICATIONS
10-5-8 SOILS AND GEOLOGY REPORT
10-5-9 DRAINAGE POLLUTION AND EROSION CONTROL
10-5-10 GENERAL REGULATIONS

174

→10-5-11 EXCAVATION
→10-5-12 GROUND PREPARATION FOR EMBANKMENTS
10-5-13 EMBANKMENT AND BACKFILL
10-5-14 SETBACKS
10-5-15 PERMIT ISSUANCE
10-5-16 PERMIT SUSPENSION OR REVOCATION
10-5-17 FEES
10-5-18 BONDS
10-5-19 GRADING INSPECTION
10-5-20 COMPLETION OF WORK

ARTICLE 6. IMPROVEMENTS - SPECIFICATIONS
10-6-1 PREPARATION
10-6-2 PROCEDURE

ARTICLE 7. MODIFICATION OF PROVISIONS - INTERPRETATIONS
10-7-1 APPLICATION
10-7-2 NOTICE
10-7-3 CONSIDERATION OF APPLICATION
10-7-4 NOTICE OF DECISION
10-7-5 EFFECTIVE DATE
10-7-6 APPEAL

ARTICLE 8. FENCES
10-8-1 GENERAL
10-8-2 PERMIT FEES
10-8-3 STRUCTURAL REQUIREMENTS
10-8-4 EASEMENTS
10-8-5 VISION CLEARANCE, PLACEMENT AND LOCATION
10-8-6 MAINTENANCE
10-8-7 COLLECTOR AND ARTERIAL STREETS
10-8-8 INTERPRETATION

CHAPTER X
LAND DIVISION AND LAND DEVELOPMENT

Article 1. GENERAL

10-1-1 Title.

This Chapter shall be known as the "Land Division and Land Development Ordinance of the City of Springfield".

10-1-2 Purpose and Intent.

The City Council hereby finds that it is necessary in order to accomplish the orderly development of land within the City to provide rules, regulations and standards to govern the approval and development of subdivisions and partitions as well as the development of existing properties, taking into consideration:

(1) Applicable plans, policies and goals; and

(2) The locations of proposed subdivisions, partitions, and developments on existing properties, as well as their impact on the surrounding area and the entire City.

It is the intent of this ordinance to minimize street congestion, ensure protection from fire, flood, soils and geological hazards, pollution and other dangers, to provide adequate light and air, to prevent overcrowding of land, to encourage energy conservation, and to facilitate adequate provisions for transportation, water supply, sewage disposal, drainage, education, recreation and other public services and facilities.

(b) All secondary conditions listed under preliminary approval shall be met after final approval has been granted by the Partition Review Committee during the building permit process, except in the case of some common wall duplex partitions. Certain secondary conditions may be met by use of a surety bond or suitable substitute as agreed upon by the partitioner and the City, to be filed with the Finance Department in sufficient amount to insure the completion of the particular condition. All secondary conditions shall be met prior to the issuance of a certificate of occupancy.

(7) Appeal of Partition Decisions.

The procedure and provisions for appeal are as follows:

(a) The Partition Review Committee's decision to approve or deny a reques for partition approval may be appealed to the Planning Commission within ten days of the decision. Planning Commission decisions are effective on the eleventh day after rendering, unless appealed to the City Council within the interim ten (10) days.

(b) Appeals may be made by any interested party and shall be in writing and filed in the Planning Department. Appeals shall state specifically how the Partition Review Committee, or the Planning Commission, as the case may be, failed to properly evaluate the proposal or to make a decision consistent with Section 10-1-2 of this Code or required findings.

(c) Appeals shall be considered at a public meeting after notifying the partitioner and appellant at least ten days in advance thereof.

(d) Partition Review Committee or Planning Commission decisions are not effective until termination of appeals pending against them.

10-2-2 Subdivision Tentative Plan Procedure.

The following is the procedure required in processing applications for subdivision tentative plan approval:

(1) Tentative Plan Application.

An application for tentative plan approval shall be made by the person proposing the subdivision or his authorized agent or representative on a form prescrib by the Planning Department. This form shall be submitted to that office, together wit a tracing and ten copies of a subdivision tentative plan.

(2) Tentative Plan Requirements.

(a) Drafting. The tentative plan shall show all required and pertinent information, normally at a scale of one inch equals 100 feet. The scale may be increased or decreased to fit standard size sheets of 18 inches by 24 inches. In all cases, the scale shall be standard, being 10, 20, 30, 40, 50, or 60 feet to the inch or multiples of 10 of any one of these scales.

Tentative plans for subdivisions shall be prepared by an engineer.

(b) Information Required. The application itself or the tentative plan must contain the following information with respect to the subject area:

(1) Name and lot numbering of proposed subdivisions. Except for the words "town", "city", "place", "court", "addition", or similar words, the name shall be clearly different than, and clearly pronounced different than the name of any other subdivision in the county unless the subject subdivision is contiguous to and platted by the same party that platted the preceeding subdivision bearing that name.

(2) The date, north point and scale of the drawing, and a sufficien description to define the location and boundaries of the proposed subdivision area, the lot number and lines and subdivision names of all such parcels of land, and the names of owners of record of all such parcels of land that are unsubdivided, and appropriate identification of the drawing as a tentative plan.

(3) A legal description and drawing of the boundaries of the entire area owned by the subdivider of which the proposed subdivision is a part; provided that where the proposal comprises all of such area, an affidavit of such fact shall accompan the tentative plan.

(4) The names and addresses of the owner(s), the engineer or surveyor, and the developer or subdivider.

(5) The existing and proposed uses of the property.

(6) The location of existing and proposed right of way lines for existing or future streets as shown on the Master Street Plan.

(7) The locations, widths, grades, and names of all existing or proposed streets, alleys, pedestrian ways, bicycle paths, or other right of way within and adjacent to the subdivision, and the approximate radii of all curves. All streets and alleys intended to be private shall be so designated. All other streets and alleys shall be dedicated for public use. If private streets are proposed, a statement shall be made as to how the construction of necessary local improvements and continued maintenance thereof will be guaranteed. Said roads, streets and alleys shall be laid out so as to conform to subdivisions previously approved for adjoining properties as to width, general direction and in other respects unless it is found in the public interest to modify the street or road pattern.

(8) The elevations of all points used to determine contours shall be indicated on the tentative plan and said points shall be given to true elevations above mean sea level as determined by the City Engineer. The base data shall be clearly indicated and shall be compatible with City datum, if the bench marks are not adjacent. The following intervals are required:

(a) Two-foot contour intervals for ground slopes up to ten percer
(b) Five-foot contour intervals for ground slopes exceeding ten percent.

(9) The approximate width and location of all existing and proposed easements for public utilities, and all reserve strips proposed to satisfy requirements which may be required as provided for in Section 10-3-1 of this Code.

(10) The approximate location of all trees and tree masses, 12 inches or more in diameter, that would interfere with public rights of way and easements.

(11) Locations, size and type of any perennial planting in public ways.

(12) The approximate lot layout and the approximate dimensions of each building site, the approximate finished grading of each lot, the preliminary design of all grading, the elevation of proposed building pads, and the top and toe of cut and fill slopes to scale. A separate preliminary grading plan may be required if putting the information on the Tentative Plan greatly impairs legibility.

→ (13) The approximate location of areas subject to inundation of storm water overflow and all areas covered by water with direction of flow of all water courses.

→ (14) Proposed plan and easements for drainage and for handling storm water overflow for the entire subdivision and for each individual building lot.

→ (15) Proposals for handling drainage, including sheet flow, from adjacent properties.

→ (16) All proposals for sewage disposal, flood control, and easements or deeds for water courses, including profiles of proposed drainage ways.

(17) The location and outline to scale of each existing structure on the property proposed for division. Structures on adjacent property shall also be shown if such structures affect the design of the proposed subdivision. Each structure that is to be retained shall also be noted.

(18) Location, size, and material for all water lines.

(19) Illuminations plans including location and size of all street lights to be provided, the power source for such lighting, and the level of illumination as outlined by the Illumination Engineer's Society standards.

(20) All public areas proposed to be dedicated by the subdivider and the proposed uses, conditions or limitations of such reservations.

(21) All public improvements proposed to be made or installed, and the time within which such improvements are envisioned to be completed.

(22) Draft of proposed restrictions and covenants affecting the proposed plat.

(23) Predominant natural features such as water courses and their flows, marshes, and rock outcroppings.

(24) Location and extent of any areas of unstable soil or slide conditions as determined by the Soils and Geology Report.

(25) Railroad rights of way and grade crossing.

(26) City boundaries which cross and adjoin the proposed subdivision.

(27) Any other information as may be required by the Director of Public Works and/or the Director of Planning.

(c) Accompanying Data. The following data shall accompany the submission of the tentative plan, if not adequately addressed thereon:

(1) Owner's Statement. Such of the foregoing tentative plan information which may not, in the judgement of the Director of Public Works, practicably be shown on the plan shall be contained in a written owner's statement.

(2) Soils and Geology Report. A Soils and Geology Report shall be submitted by the subdivider or his representative at the time of filing of the tentative plan in accordance with Section 10-5-9 of this code.

(3) Title Report. A title report no older than one month shall be submitted with the tentative plan.

(3) Tentative Plan - Preliminary Consideration by Land Development Review Committee. The Land Development Review Committee shall review the proposal, and its report shall state to the Planning Commission either:

(a) That all Code requirements have been satisfied.

(b) That one or more Code requirements have yet to be satisfied.

(c) That a number of conditions deemed necessary by the Land Development Review Committee for the safe and logical development of the property are to be satisfied.

(4) Tentative Plan - Planning Commission Options. The Planning Commission shall approve, deny, or when further information is required, postpone a decision on the application. In case of postponement, the Planning Commission must make a decision for approval or denial within 60 days of receipt by the Commission from the Director of Planning. Approval must include affirmative findings that:

(a) The division of the property does not impede the future best use of the remainder of the property under the same ownership, or adversely affect the safe and healthful development of such remainder or any adjoining land or access thereto, and

(b) The tentative plan complies with the requirements of its submittal, Section 10-1-2 of this Code, and City Ordinances 3801 and 3802.

Except as provided for in the procedure for modification as stipulated in Article 7 of this Code, approval as stipulated herein does not relieve the subdivider from other applicable provisions of Oregon Revised Statutes or this Code.

(5) Tentative Plan - Effective Date. Unless appealed, the Planning Commission decisions shall become effective on the 31st day after they are rendered. The subdivider may then proceed with final surveying and preparation for final approval consideration of the subdivision plat. Tentative plan approval shall be effective for one year, within which time the application and subdivision plat must be submitted as required by this Code to the Planning Department. Otherwise, the entire procedure must be repeated for reconsideration.

(6) Tentative Plan - Appeal of Decisions. The procedure for provisions for appeal are as follows:

(a) Planning Commission decisions are effective on the 31st day after rendering unless appealed to the City Council within the interim 30 days.

(b) Appeals may be made by any interested party and shall be in writing and filed with the Planning Department. Appeals must state specifically how the Planning Commission failed to properly evaluate the proposal or to make a decision consistent with Section 10-1-2 of this Code and/or the required findings of Section 10-2-2 at Subsection 4.

ARTICLE 4. Design Standards

10-4-1 Design Standards -- General

To ensure that all developments reflect the best interests of the City as expressed in Section 10-1-2 of this Code, all developments governed by the provisions of this chapter shall conform to the design standards set forth in this Article.

10-4-2 Design Standards - Land Surface Drainage.

Such grading shall be done and such drainage facilities shall be constructed by the land divider as are necessary for the proper drainage of the partition or subdivision, or areas affected thereby, and for the preservation of healthful and convenient surroundings and conditions for residents of the subdivision or partition, and for the general public in accordance with Standard Construction Specifications as prepared by the Director of Public Works.

10-4-3 Design Standards -- Storm Drains

(1) Runoff.

Storm water runoff from the development shall be collected and conveyed by a storm drain system approved by the Director of Public Works. Maximum runoff shall be computed using the Rational Method. The Intensity-Duration Curve for rainfall, figure 8-22 in the Oregon State Highway Division's Hydraulics Manual, and "C" values approved by the Director of Public Works shall be used in the computation. Runoff Computations and resultant drainage facilities shall anticipate and accomodate full future development within the drainage area. In cases where the drainage area is undeveloped, ultimate development shall be determined by the designation of the area on the comprehensive plan and the zoning for the area. The storm drain system shall provide for the protection of abutting properties that would be adversely affected by any change in runoff attributed to the development; offsite storm drain improvements may be required.

(2) Capacity of Channels and Conduits.

Drainage channels and conduits shall have the following minimum capacities:

(a) Major Drainage Channels.

Major drainage channels and conduits shall have sufficient capacity to contain a 10 year frequency of occurrence runoff.

(b) Secondary Drainage Channels.

Secondary drainage channels and conduits shall have sufficient capacity to contain a 5 year frequency of occurrence runoff.

(c) Minor Drainage Channels.

Minor drainage channels, conduits, and appurtenant facilities shall have sufficient capacity to contain a 2 year frequence of occurrence runoff.

(3) Closed Conduit System.

Storm water shall be placed in conduits when the gutter flow comes within one inch of the top of the curb or when the flow encroaches on the traveled portion of the street. Open flow shall not be allowed across a street. Storm water in natural or artificial drainage channels shall be placed in closed conduits, except that the Director of Planning may recommend that an existing natural water course, endowed with significant natural beauty in the form of trees, shrubs, or scenic attraction, may be utilized for an open drainage facility with such improvements as may be designated by the Director of Public Works when such areas are dedicated for public use.

(4) Conduit.

The minimum conduit size shall be 10 inches. All storm sewers shall have a minimum invert grade not less than that which provides a minimum velocity of 3 feet per second for the design flow. Curves in conduit must be approved by the Director of Public Works and radii shall not be less than those recommended by the pipe manufacturer.

(5) Manholes.

Except in curved sewers, standard manhole shall be constructed at all changes in horizontal or vertical alignment and at least one manhole shall be constructed at all pipe intersections. The maximum distance between manholes shall be 500 feet or as directed by the Director of Public Works.

(6) Catch Basin Structures.

City standard catch basin structures shall be constructed at each pickup point in the system. The type of City standard catch basin shall be constructed as directed by the Director of Public Works. No more than two catch basins shall be on any one lateral line. The maximum difference between inlet elevations and pipe outlet flow line elevation shall be 5 feet.

A curb inlet type catch basin shall be required whenever a catch basin has both inlet and outlet pipes.

(7) V-Ditches. City standard V-ditches may be used to intercept runoff from slopes. The City shall not accept maintenance of V-ditches. Design flow in V-ditches shall be at one inch below the top of the ditch. Pickup points in V-ditches shall be at locations approved by the Director of Public Works.

10-4-4 Design Standards -- Sanitary Sewers

(1) DEQ Regulations. All lots and parcels within subdivisions and partitions shall be served by sanitary sewers designed and constructed in accordance with the provisions of this section and the regulations of the Oregon State Department of Environmental Quality (DEQ). In case of conflict between these regulations and the DEQ regulations, the more stringent regulation shall govern.

(2) Sewer Service. Each building site within the development shall be provided with sewer service from an approved system.

(3) Pipe Size. All sanitary sewer mains shall be at least 8 inches in diameter and all sewer laterals shall be at least 4 inches in diameter. The City shall not accept maintenance of any 4 inch diameter sewer laterals.

(4) Slope. All sanitary sewer mains shall have a minimum invert grade not less than that which will provide a minimum velocity of 2 feet per second at the design flow.

(5) Cover. All sanitary sewer mains shall have a minimum cover of 30 inches measured from the surface of the pavement to the top of the pipe.

(6) Materials. In general, sanitary sewer mains may be constructed of ABS, PVC, or concrete pipe as specified in the Standard Construction Specifications. Pressure sewer mains shall be cast iron, or where approved by the Director of Public Works, asbestos-cement pressure pipe.

(7) Manholes. A City standard manhole shall be constructed at all changes in horizontal and vertical alignment and at least one manhole shall be constructed at all trunk line intersections. A City standard clean out or manhole shall be constructed at all dead ends.

(8) House Laterals. All house laterals shall ordinarily be placed at right angles to the sanitary sewer main and shall be connected to the main by a wye or a tee. Manholes may be required where laterals join the main line. The location of house laterals shall be designated as required in the Standard Construction Specifications.

10-4-5 Design Standards - Planting.

(1) Roadway Plantings. Plantings bordering public ways shall be as directed by the Planning Commission or the Site Plan Review Board.

(2) Existing Trees. Existing trees shall be preserved whenever possible and when approved grading will so permit. When such trees exist, the Director of Public Works may require an inspection to determine their health. For trees in the public right of way see Chapter 2 Article 8.

(3) Slope Planting. All cut and fill slopes shall be planted as directed by the Director of Public Works and the Director of Planning, as provided in Section 10-5-9 of this Code.

(4) Landscaping. Landscaping of public and private land shall be as directed by the Planning Commission or the Site Plan Review Board.

(c) Specifications controlling construction methods and materials in construction of the work including:

(1) Provisions for control of grading operations within the construction area on public roads;

(2) Safety precautions to be observed, and facilities to be provided;

(3) Compliance with all pertinent laws and local regulations;

(4) Control of dust;

(5) Hours during which work will be permitted;

(6) Other related matters.

(d) Plans and details of walls, cribbing, slope protection, facilities and planting (Planting plans will be subject to the approval of the Director of Public Works).

(4) Specifications for the removal and disposal of excess material.

→10-5-8 Soils and Geology Report.

(1) Unless waived by the Director of Public Works, a Soils and Geology Report, prepared by an engineer, shall be submitted by the developer or his representative. The Director of Public Works may require that the engineer consult with a registered geologist or registered certified specialty geologist in preparation of this report.

In order to provide the engineer with the information necessary for determining both the types of structures which can be placed on the land and the types of drainage facilities which will be necessary, the report shall contain adequate data and recommendations on the following matters:

→ (a) A general indication of both surface and subsurface drainage facilities necessary to secure stability of native soil or compacted fill.

(b) The location of areas within the boundaries of the development which can justifiably and safely be used for building sites, with accompaning diagram.

(c) Guidelines to be used to adequately and properly develop and maintain the area under consideration, such as the desirable height of cuts and fills, desirable steepness of slopes, recommended erosion control measures, retaining wall locations, necessary corrective measures, etc.

(d) An analysis of areas immediately adjacent to the proposed development which, after grading, might have an adverse effect upon the proposed development or might be adversely affected by the grading.

(2) Requirements for excavations and fills for any building or structure, and for foundations and retaining structures shall be governed by Chapter 29 of the State Building Code.

(3) When the Soils and Geology Report indicates the presence of critically expansive soils or other soil problems which, if not corrected, would lead to structural defects, the developer or his representative shall submit a report which addresses each lot or area with said soil conditions. This investigation shall recommend corrective action which is likely to prevent structural damage to the proposed structures. When these further studies are necessary, all buildings, structures, and public or private improvements shall be designed in accordance with the recommendations contained in these studies.

(4) When a preliminary report backed by sufficient data and prepared by the engineer indicates that the soils quality of the proposed development does not require further analysis, the Director of Public Works may, based upon this information, determine that a complete Soils and Geology Report is not required.

→10-5-9 Drainage Pollution and Erosion Control

(1) When required by the Director of Public Works, drainage facilities and pollution and erosion control devices shall be provided to convey storm waters to a natural channel or water course or to a storm drainage facility in an acceptable manner without causing pollution, erosion, or damage and such facilities shall be designed so as to provide the capacity deemed to be necessary by the Director of Public Works.

(2) (a) When work done under a grading permit indicates the presence of subsurface waters which may contribute to sliding or settlement of the earth surface either in an undisturbed state, or that such subsurface waters are expected to result from the grading operations, the Director of Public Works may require the construction of, or installation of such subsurface and surface facilities as may be deemed necessary to collect anticipated slide or settlement conditions, and require its conveyance to an acceptable point of discharge.

(b) Whenever during excavation there are uncovered or become apparent any unforseen springs, aquifers, or sources of underground water, all grading operations in the immediate area may be stopped when deemed necessary by the Director of Public Works. If grading operations are so halted, they shall not be resumed until the drainage facilities recommended by an engineer for the remedy of the condition have been completed and approved.

(3) Graded sites shall be sloped a minimum of two (2) percent to provide adequate drainage.

(4) (a) Whenever slope surfaces or excavations and embankments exist, or result from grading operations on the site, erosion control shall be installed by October 1st; if grading operations occur from October 1 through April 30, erosion control shall be installed within fourteen (14) days from denuding.

→ (b) Erosion control measures shall conform to the recommendation within the Soil and Geology Report and shall be approved by the Director of Public Works. Such measures shall consist of surface roughening, interceptor and diversion practices, vegetative soil stabilization, and non-vegetative soil stabilization.

→ (c) Temporary or short-term stabilization shall be required in accordance with paragraph (a) above when necessitated by prolonged grading delays or by completion of final grading during seasons of the year when permanent vegetative soil stabilization cannot be performed. Temporary or short-term stabilization shall conform to the recommendation within the Soil and Geology Report and shall be approved by the Director of Public Works.

10-5-10 General Regulations

(1) Excavation, grading or construction of fills may be prohibited by the Director of Public Works during the period in which rainfall precludes compliance with requirements herein set forth.

(2) If operations under the grading permit are within five hundred (500) feet of residential or commercial occupancies, grading operations shall be limited to the hours of six (6) a.m. to eight (8) p.m. daily, with Sunday operations prohibited, excepting that maintenance and service work on equipment may be performed at any time subject to regulation by Section 5-12-8 of the Springfield City Code.

(3) Encroachment of operations on public rights of way without a permit from the Director of Public Works is prohibited except for hauling of legal loads by vehicles permitted to operate on public roads by law.

(4) Operations shall be controlled to prevent nuisances to public and private ownership because of dust, drainage, water pollution, soil erosion, removal of natural support of land and structures, encroachment, noise and vibration.

(5) Blasting, or other uses of explosives shall be subject to regulation by Chapter 7, Article 6, of the Springfield City Code.

(6) Excavation, grading, and construction of embankments in, on, under, over or adjacent to old fills, and areas known to be, or believed to be, potential slide areas, shall not be permitted until a Soils and Geology Report prepared by an engineer has been submitted to the Director of Public Works with the application for a grading permit, and such report certifies that the proposed construction will be stable within itself and will not be hazardous to any adjoining property or to any public road, utility or other facility. Recommendations presented in the Soils and Geology Report as to materials, equipment or procedures to be incorporated in the construction area or

operations to ensure adequate stability and safety in the construction area, or to the adjoining areas which may be affected by the proposed construction, together with other reasonable requirements, may be incorporated in the grading permit as a condition of approval of the application.

(7) All grading done under this Chapter must substantially conform to the design and layout of the approved or conditionally approved tentative plan and a violation of this clause may be grounds for suspension or revocation of the grading permit as prescribed in Section 10-5-16 of this Code, as well as being subject to the penalty provisions of this Code.

10-5-11 Excavations

(1) Unless otherwise permitted, the slope of any bank in an excavation shall not be steeper than one and one half (1½) horizontal to one (1) vertical, except that such slope may be required to be flatter if soil conditions are found to be unfavorable, or an adjacent foundation or structure may be endangered.

(2) Terraces at least six (6) feet in width shall be established at not more than thirty (30) foot vertical intervals on all cut slopes to control surface drainage and debris except that where only one terrace is required, it shall be at mid-height. For cut slopes greater than sixty (60) feet and up to one hundred twenty (120) feet in vertical height one terrace at approximately mid height shall be twelve (12) feet in width. Terrace widths and spacing for cut slopes greater than one hundred twenty (120) feet in height shall be designed by an engineer and approved by the Director of Public Works. Terraces shall have a transverse slope of not less than five (5) horizontal to one (1) vertical sloping down towards the bank above the terrace and a longitudinal slope of not less than two (2) percent. Suitable access shall be provided to permit proper cleaning and maintenance pursuant to Section 10-1-8 of this code. Swales or ditches on terraces shall have a minimum gradient of five (5) percent and must be paved with concrete not less than three (3) inches in thickness or an approved equal paving. They shall have a minimum depth at the deepest point of one (1) foot and a minimum paved width of five (5) feet. A single run of swale or ditch shall not collect runoff from a tributary area exceeding 13,500 square feet (projected) without discharging into a down drain.

(3) Cut slopes shall be provided with subsurface drainage as necessary for stability.

10-5-12 Ground Preparation for Embankments.

(1) The area on which an embankment or fill is to be placed shall be cleared of all vegetation, such as trees, logs, stumps, and roots of trees, brush, heavy growth of grass and weeds, and any other objectionable material, such as debris, concrete foundations, metal, or non-earthen materials which cannot be properly consolidated or will not support the load of the embankment or structures. The cleared area shall extend to a width of two (2) feet outside the area to be filled. All trees, existing stumps and large roots shall be removed, except that within the area where fills will be three (3) feet or more in height, trees may be cut flush with the existing ground and grubbing of the remaining stumps will not be required except at locations where subdrainage, trenches, drain pipes, foundations or other structures are to be constructed or where unsuitable material is to be removed before construction of the embankment.

(2) The existing ground shall be prepared to receive fill construction by:

(a) The installation of subdrains to intercept and dispose of waters from springs, aquifers, or other underground sources of water; and storm drains to intercept and dispose of surface waters where required on approved plans.

(b) Compacting the ground area upon which any embankment is to be constructed to a minimum relative compaction of ninety (90) percent throughout the top six (6) inches.

Lane Council of Governments
NORTH PLAZA LEVEL PSB / 125 EAST EIGHTH AVENUE / EUGENE, OREGON 97401 / TELEPHONE (503) 687-4283

May 21, 1982

No. 13.a.

TO: L-COG Board of Directors

FROM: Areawide Water Resources Advisory Committee

SUBJECT: Urban Runoff (NURP) Program Recommendations

BACKGROUND

The 208 Advisory Committee (now the AWRAC) has participated and reviewed the progress of the urban runoff study over the last several years. The study has produced a series of technical reports on street sweeping, vegetation management, sediment control and financial management. These reports, in particular the report on the Financial Management (drainage utility), formation were prepared in close coordination with Eugene and Springfield staffs and are being considered by these agencies for implementation.

The AWRAC felt that some general recommendations covering an overall consideration of the urban runoff study results are appropriate, primarily as a means of setting a context and providing a additional stimulus for the continued efforts on the parts of the cities to move forward in addressing this source of environmental pollution.

As a consequence, the AWRAC considered a series of recommendations on May 5, 1982 and voted to support important revised general recommendations in order to proceed on this issue.

These recommendations are as follows:

1. In order to be in compliance with and pursue implementation of adopted Metropolitan Planning Goals relating to Environmental Resources, River and Waterway Corridors and Environmental Design Elements, each city should prioritize urban runoff control activities and allocate funding to these activities based on these priorities.

2. In setting such priorities, the Cities of Eugene and Springfield should take particular note of the "special Concern Areas" as well as the pollution sources for each Concern Area as identified by the Areawide Water Resources Committee.

   These concern areas include Fern Ridge Reservoir (source-Amazon Creek); Bertelsen Slough (source-industrial areas in West Eugene); Alton Baker Park (source-"Q" Street Channel and central-east Springfield); and, Island Park (source-storm drainages in downtown Springfield).

3. Eugene and Springfield should establish a storm runoff and drainage service charge system and a portion of the funds generated from such user charges should be allocated to urban runoff pollution control. Such a service charge system should be fair and should be used, where appropriate, to reduce the tax burden on the General Fund.

4. Special efforts should be made to implement "runoff enhancement" programs, particularly regarding the establishment of spill prevention and cleanup plans, on-going monitoring programs, public involvement efforts and comprehensive channel and channel-vegetation management schedules.

5. Both Eugene and Springfield should maintain accurate maps and records on the sources of urban runoff pollution and chemical spills as well as on the location and beneficial uses associated with each drainage in their jurisdiction.

6. Eugene and Springfield should consider the results of the 208 Study and utilize the technical and financing reports as appropriate in implementating an urban runoff control and quality enhancement program.

ACTION REQUESTED

Consider authorization to forward the above recommendations to the City Managers of Eugene and Springfield on behalf of the Areawide Water Resources Advisory Committee.

ACTION TAKEN

This information was presented to the L-COG Board on May 27, 1982 and the requested action was approved.

APPENDIX I

ANNOTATED BIBLIOGRAPHY

URBAN RUNOFF MANAGEMENT

REFERENCE LIST
Contents Code

Topic

1. Urban Runoff Hydrology - quantity, distribution
2. Urban Runoff Quality - general waterway and control programs
3. Urban Runoff Pollution Sources
4. Stormwater Detention - infilitration - retention
5. Stormwater Conveyance
6. Sediment Trapping
7. Vegetation Management
8. Erosion and Sedimentation
9. Street Maintenance
10. Commercial Site Runoff
11. Residential Site Runoff
12. Developing/Construction Site Runoff
13. Industrial Site Runoff
14. Critical Areas - riparian vegetation, wetlands, recharge, floodplain
15. Stormwater Treatment large scale / chemical addition)*
16. Public Involvement

Information Catagory

A. Problem Analysis, Research Methods, Modeling
B. Research Results
C. Economic Analysis, Funding, Impact Analysis
D. Techniques, Designs, Programs, Operations
E. Legislation, Legal Aspects, Enforcement

---

* Parentheses around Code indicates discussion was very general and probably not very useful.

URBAN RUNOFF MANAGEMENT

L-COG ANNOTATED REFERENCE LIST

SHELF #		CONTENTS CODE
UR 1	Sources, Effects and Control of Urban Runoff. Robert Pitt (1979)	2-3/ABC
UR 2	Burnt Bridge Creek Drainage Management. Kramer, Chin and Mayo, Inc. (Seattle) (June 1977)	1-2/DE
UR 3	Stormwater Management Procedures and Methods. Snohomish Co. (Incomplete copy of Manual)	12/ADE (1/A, 4D)
UR 4	Collection of Field Data for Stormwater Model Calibration. Philip E. Shelley (1976)	1/A
UR 5	Water Resources Protection Measures in Land Development A Handbook. Joachim Tourbier & Richard Westmacott (U.DEL.) (April 1979)	1-2/DE (4-5-6-7-8 9-10-12-13-14/D)
UR 6	(URM Model Designs - incomplete publication) City of Anchorage (1978)	4-5-6-8/D
UR 7	On-Site Surface Water Management - A King Co. Development Assistance Handbook. Karen Rahm & Robert W. Ramsey (1977)	4-12/DE
UR 8	Residential Storm Water Management - Objectives, Principles and Design Considerations. (ULI.ASCE, NAHB) (1975)	1-4-5/AD(E)(2A)
UR 9	Residential Erosion and Sediment Control - Objectives, Principles and Design Considerations. (ULI,ASCE.NAHB)(1978)	6-8-12/AD(E)(7D)
UR 10	Suspended and Dissolved Solids Effects on Freshwater Biota - A Review. Darwin L. Sorensen, Margaret M. McCarthy, E. Joe Middlebrooks and Donald B. Percella (EPA Environmental Research Lab. Corvallis) (April 1977)	2/AB (8/AB)
UR 11	Comprehensive Erosion and Sediment Control Training Program for Engineers Architects and Planners. Harry L. Porter, Jr. (March 1976)	8/ABCD (1/A 7/B 12/D)
UR 12	Overland Park - Community Improvement and Planning Program Clackamas Co. Planning Dept. (June 1977)	(1-2/DE)
UR 13	Considerations in Characterization of Urban Runoff for PL92-500 Section 208 Planning Francis J. Candon (December 1975)	1-2-3/A

URBAN RUNOFF MANAGMENT (continued)

L-COG ANNOTATED REFERENCE LIST

SHELF #		CONTENTS CODE
UR 14	Water Quality Effects of Potential Urban Best Management Practices. Gary Oberts, (DNR Wisc) (1977)	2-3/AD(C) (4-5-6-7-8-9/AD)
UR 15	Water Pollution Aspects of Street Surface Contaminants. James D. Sarter and Gail B. Boyd (1972)	3-9-10-11 13/ABD
UR 16	Juanita Creek - Your Stream's Future. King Co, WA. Div. of Planning (August 1977)	16/D
UR 17	Stream and Lake Front - Field Inventory, Loraine Co (OH) Water Pollution Study. Loraine Co. Regional Planning Commission (1967)	(3/A)
UR 18	Emperical Estimation of Flood-Detention Capacity Needed to Offset Effects of Urbanization on Peak Streamflow. Thomas R. Hammer (Phila. Pa.) (July 1972)	1-4/AB
UR 19	Perception and Use of Streams in Suburban Areas: Effects of Water Quality and Distance from Residence to Stream. R. E. Coughlin et al. (March 1972)	(16/AB)
UR 20	Impact of Urbanization on Peak Streamflow. Thomas R. Hammer (June 1973)	1/AB
UR 21	Stream Channel Enlargement Due to Urbanization. Thomas R. Hammer (May 1972)	5-8/AB (10-11-12-13/AB)
UR 22	The Intensity of Development Along Small and Medium Sized Streams in Suburban Philadelphia. R.E. Coughlin, S. Sheldon, T. E. Hammer (September 1971)	(7-11/AB)
UR 23	Water Quality Impacts of Unsewered Housing. William T. Howard and Thomas R. Hammer (September 1973)	2-3-11/AB
UR 24	Practices for Controlling Erosion and Stormwater Runoff Draft. Jim Jordan (Tahoe Reg. Pln. Agency) (Dec. 1975)	5-6-7-8-9-12/DE
UR 25	The Bellevue Experience - A Study of Social, Political and Environmental Action. Hall and Corwin Associates (November 1976)	16/DE
UR 26	Methods to Control Fine Grained Sediments Resulting from Construction Activity. Robert Thronson (EPA) (Dec. 1976)	4-6-8-12/ABCD

URBAN RUNOFF MANAGMENT (continued)

SHELF #	L-COG ANNOTATED REFERENCE LIST	CONTENTS CODE
UR 27	Nomographs for Ten-minute Unit Hydrographs for Small Urban Watershed. Wm. H. Espey, Jr., Duke G. Altman and Chas. B. Graves, Jr. (December 1977)	1/AB
UR 28	Storm Water Management Model - Level I - Preliminary Screening Procedures. J. P. Heaney, W. C. Huber. S. J. Nix (EPA) (October 1976)	1-2/ABC (4-6/C)
UR 29	Water Pollution Aspects of Urban Runoff. (FWPCA & APWA) (January 1969)	2-3-9-10-11-13/ABD(C) (1-4-6-16/B)
UR 30	A Statistical Method for Assessment of Urban Stormwater Loads - Impacts - Controls. Dennis N. Athayde (EPA) (May 1979)	1-2-3-4-5-8-9/ABCD
UR 31	Michigan Soil Erosion & Sedimentation Control Guidebook. Dept. Natural Resources (February 1975)	4-5-6-7-8/D 12/ADE
UR 32	Stormwater Management Master Plan for Davis County, Utah. Wiggins-Wimer & Assoc. (EPA) (May 1978)	1-2-4-5/DE
UR 33	Water Quality Management and the Homebuilding Industry. (EPA, NAHB) (April 1978)	11-12/E
UR 34	Preventative Approaches to Stormwater Management. Abt Assoc. Inc. (EPA) (January 1977)	1-3-4-5-6 7-8-9-12-14 /ADCE
UR 35	Water Quality Management Planning for Urban Runoff. G. Amy, R. Pitt, R. Singh, W. L. Bradford, M. B. LaGraff (September 1975)	1-2-3-5-9/AB (4-6-7-15/D)
UR 36	Proc. Urban Stormwater Management Seminars. Dennis Athayde (EPA) (January 1976)	1-2-3-4-5-6 7-8-9-12-16/ ABCDE
UR 37	Urban Stormwater, Management Workshop Proceedings Richard Field et al. (EPA) (August 1968)	1-2-6-9-10 11-13-15/ACD
UR 38	Comparative Costs of Erosion and Sediment Control, Construction Activities. Robert E. Thronson (EPA) (July 1973)	4-6-7-8-12/ ABCD
UR 39	Processess, Proceedures and Methods to Control Pollution Resulting from all Construction Activity. Robert E. Thronson (EPA) (September 1977)	4-7-8-12/ DE

URBAN RUNOFF MANAGEMENT (continued)

SHELF #	L-COG ANNOTATED REFERENCE LIST	CONTENTS CODE
UR 40	Urban Stormwater Management Modeling and Decision Making. James P. Heaney et al. (EPA) (May 1975)	1-2/ACE
UR 41	Urban Rainfall Runoff - Quality Data Base. Wayne C. Huber, James P. Heaney (EPA) (July 1977)	1-2/AB
UR 42	Nonpoint Source Control Guidance. Construction Activities Robert E. Thronson (EPA) (December 1976)	4-6-7-8-12/AD
UR 43	Control of Erosion and Sediment Deposition from Construction of Highways and Land Development. Robert E. Thronson (EPA) (September 1971)	8-12/AD
UR 44	Guidelines for Erosion and Sediment Control Planning and Implementaton. Dept. Wat. Res. Md., Burton C. Baker, Thomas R. Mills (EPA) (August 1972)	8-12/D
UR 45	Stream Quality Preservation Through Planned Development. Robert E. Coughlin and Thomas R. Hammer (EPA) (May 1973)	1-2-3-11 16/ABC
UR 46	Methodology for the Study of Urban Storm Generated Pollution and Control. Richard E. Wullschleger, Alphonse D. Zanoni, Charles A. Hanson (EPA) (August 1976)	1-2-3-15/ A
UR 47	Evaulation of Water Quality Models: A Management Guide for Planners. G. Paul Grimsrud, E. John Finnemore, H. James Owen (EPA) (July 1976)	(1-2/A)
UR 48	Storm Water Management Model - Users Manual Version II. Wayne C. Huber et al. (EPA) (March 1975)	1-2/A
UR 49	Urban Stormwater Managment & Technology. An Assessment John A. Lagler, William G. Smith (EPA) (December 1974)	1-2-3-4-5-15/ABCD
UR 50	Changes in Water Quality Resulting from Impoundment. William R. Duffer, Curtis C. Harlin (EPA) (August 1971)	(6/AB)
UR 51	Rainfall-Runoff Relations on Urban and Rural Areas. Ernest F. Brater, James D. Sherrill (EPA) (May 1975)	1/AB
UR 52	Urban Stormwater Runoff: Determination of Volumes and Flowrates. Vente Chow, Ben Chie Yen (EPA) (May 1976)	1-4-5/AB
UR 53	Integrated Land Use/Air Quality/Water Quality Control Study for Sonoma Co. California. Gorden Jacoby et al. (EPA) (January 1977)	2-3-4-6-9-10-11-13/ CDE

URBAN RUNOFF MANAGEMENT (continued)

L-COG ANNOTATED REFERENCE LIST

SHELF #		CONTENTS CODE
UR 54	Comparative Analysis of Urban Stormwater Models. Battelle Mem. Inst. (August 1974)	1-2/A
UR 55	Suggested Criteria for Hydrologic Design of Storm-Drainage Facilities in the San Francisco Bay Region, California. S. E. Rante (1971)	1/AB
UR 56	Construction and Material Specifications and Drawings, Channel A-3 Improvement, Oregon. U.S. Soil Conservation Service (1966)	5/D
UR 57	Watershed Work Plan Lower Amazon and Flat Creek. N. Lane SWCD et al (October 1965).	1-5/ACD
UR 58	Stormsewer and Drainage Study - River Road/Santa Clara, Lane County, Oregon. Walter Swainson, Michael Kirby (CH2M/Hill) (April 1975)	1-5/ACDE
UR 59	Drainage Management Literature Review - Portland-Vancouver Metro Area Water Resources Study. Kramer, Chin & Mayo, Inc. (March 1978)	1-2/AE
UR 60	Portland-Vancouver Metro Area Water Resources Study-Plan of Study. US Army Engineer Dist. Portland (May 1976)	1-2-16/ADE
UR 61	Basic Data on Urban Storm-Water Quality, Portland, Oregon Stuart McKenzie and Timothy Miller (USGS) (1976)	1-2/AB
UR 62	Portland-Vancouver Metropolitan Area Water Resources Study - draft Drainage Management Study. U.S. Army Engineer Dist. Portland (March 1979)	1-4-5-16/ ACDE
UR 63	Guidebook for Screening Urban Nonpoint Pollution Management Studio Draft. Metropolitan Washington COG (Nov. 1979)	3-4-6-9-10-11-12-13/ ABCE
UR 64	Analysis of Street Sweepings. Portland, Oregon. Timothy Miller, Joseph Rinella, Stuart McKenzie, Jerry Parmenter, USGS (1977)	9/AB
UR 65	Water Quality Aspects of Combined Sewer Overflow. Tech. Sup. 2. draft. CRAG-Merlin Villnaner (City of Portland) (September 1977)	1-2-3-5/ AB
UR 66	Water Quality Aspects of Urban Stormwater Runoff. Tech. Sup. 3 draft. CRAG-Bruce Warner (US. ACE) (Sept. 1977)	1-2-3-/ABD (4-9-12/D)

SHELF #	L-COG ANNOTATED REFERENCE LIST	CONTENTS CODE
UR 67	Analysis of Urban Stormwater Quality from Seven Basins in the Portland Area, Oregon. Tech. Sup. 4. CRAG T. Miller. S McKenzie (USGS) (1978)	1-2-3-9/AB
UR 68	Level III: Receiving Water Quality Modeling for Urban Storm water Management. Miguel Medina, Jr. (EPA) (August 1979)	1-2-3-5/AB
UR 69	Urban Stormwater Analysis. Eugene-Springfield Metropolitan Area. Jordan/Avent & Assoc. (September 1977)	1-2-3/AB
UR 70	208 Wastewater Management Program Summary Report. Gerritt Rosenthal. (L-COG) (December 1977)	(1-2-3-13/A)
UR 71	Upper Willamette River Basin Industrial Wastes Study Gerritt Rosenthal. (L-COG) (September 1978)	1-2-3-5-13/ BD (4-7/D)
UR 72	Revised Urban Storm Runoff Management Study - Summary Report. Gerritt Rosenthal. (L-COG) (January 1978)	1-2-3-4-5-6 7-8-9-10-12 13-16/AD
UR 73	Stormwater Drainage Study for East Springfield (J. C. Detweiler) Brown and Caldwell (June 1979)	1-4-5/ABCD
UR 74	Distribution of Metals in Street Sweepings, Stormwater Solids and Urban Aquatic Sediments. Wm. Wiler, Joseph Kenta (December 1979)	2-3-9-10-11 -13/ABD
UR 75	Annotated Tables of Vegetation Growing on Dredged Materials Throughout the United States. Mary Landin (USACE) (December 1978)	7/BD
UR 76	Strategies for Protection and Management of Floodplain Wetlands and Other Riparian Ecosystems. Proc. of Symp. U.S. Forest Service. (December 1978)	7/ABCDE
UR 77	Bacterial Characteristics of Stormwaters in Developing Rural Areas. Ernst Davis (EPA) (August 1979)	23/ABD
UR 78	Screening/Floatation Treatment of Combined Sewer Overflows. Vol. II: Full-Scale Operation. Racine, Wn. T.L. Meinholz et al. (EPA) (August 1979)	3-5-15/ABCD
UR 79	Disinfection/Treatment of Combined Sewer Overflows - Syracuse, NY. Frank Drehwing et al. (EPA) (August 1979)	3-5-15/ABCD
UR 80	Dry-Weather Deposition and Flushing for Combined Sewer Overflow Pollution Control. Wm. Pisan et al. (EPA) (August 1979)	3-5-8-15/ABCD

URBAN RUNOFF MANAGEMENT (Continued)

SHELF #	L-COG ANNOTATED REFERENCE LIST	CONTENTS CODE
UR 81	Evaluation of the Cost-Effectiveness of Nonstructural Pollution Controls: A Manual for Water Quality Management Planning. CONSAD Research Corp. (EPA) (Apr. 1979)	2/CE
UR 82	Demonstration of Nonpoint Pollution Abalement Through Improved Street Cleaning Practices. Robert Pitt (EPA) (Aug. 1979)	3,9/ABCD
UR 83	ISCO Open Channel Flow Measurement Handbook. Instrumentation Specialities Co. (1978)	1/A
UR 84	Urban-Runoff-Rainfall-Quality Data Base. W.C. Huber, J.P. Heaney, K.J. Smolenyak, D.A. Aggidis (EPA) (Aug. 1979)	1,2,3/AB
UR 85	Sampling of Water and Wastewater P.E. Shelly (EPA), (Aug. 1977)	2/A
UR 86	Environmental Planning: The Role of Financial Analysis Draft. (EPA) (May 1980)	1-2-16/CD
UR 87	Planning for Urban Stormwater-Management: Financial Issues and Options. Draft (EPA) (Apr. 1980)	1-2/CD
UR 88	Case Study. Surface Water Management Utility Program, Clark Co., Washington draft, (EPA Region X) (Apr. 1980)	1-2/CD
UR 89	Urban Hydrology, A Systems Study in Knoxville Tenn. R. Betson (TVA) (June 1976)	1-2/AB
UR 90	Monitoring of Toxic Pollutants in Urban Runoff: A Guidance Manual. D. Dixon, (VERSAR, Inc.) (Oct. 1980)	1-2-3/A
UR 91	The Potential of Cattails as an Energy Source. D.C. Pratt, V. Bonnewell, N.J. Andrews, J.H. Kim, (Feb. 1980)	7/ABD
UR 92	Stormwater Management Alternatives. J.T. Tourbier, R. Westmacott, (U. Del.) (Apr. 1980)	1-2-4-5-6-14-16/ BCDE

URBAN RUNOFF MANAGEMENT (Continued)

SHELF #	L-COG ANNOTATED REFERENCE LIST (Con't)	CONTENTS CODE
UR 93	Erosion and Sediment Control Programs - Six Case Studies, National Assoc. of Conservation Districts. (1976)	8-12/DE
UR 94	Storm Drain Utility Formation and Rate Report City of Tacoma, Washington, (Feb. 1979)	2/CDE
UR 95	Sewage Disposal and Drainage Regulation and Rates, City of Tacoma, Washington, (Apr. 1979)	2/CE
UR 96	Stormwater Quality Summary. New Castle Co., Delaware. (Sept. 1975)	3-4-6-7-8-9-15/BD
UR 97	National City of Urban Erosion and Sediment. Control, W.L. Downing, (EPA), (Oct. 1980)	24-6-7-8-9-15/BD ABCDE

SHELF #	CITY OF EUGENE ANNOTATED REFERENCE LIST	CONTENTS CODE
E2	Henrico Co. Virginia Erosion and Sediment Control Handbook. Henrioc Co. Va	46812/CDE
E2	Maximum Utilization of Water Resources in a Planned Community - Executive Summary Wm. Characklis et al. (EPA) (July 1979)	1-2-3-4-9/ABD
E2	Combined Sewer Overflow Abatement Program. Rochester, N.Y., Volume II Pilot Plant Evaluation, Frank Drehwing, et al. (EPA) (July 1979)	5-15/ABC
E2	Urban Runoff Control Planning, M.B. McPherson (EPA) (Oct. 1978)	1-2/ABDE
E2	Assessment of Mathematical Models for Storm and Combined Sewer Managment. Battele Pacific Northwest Labs (Aug. 1976)	1-2-5/A
E2	"An Approach to Urban Pollutant Washoff Modeling" Franklin Ellis and Roger Sutherland (CH2M/Hill) (July 1979)	2-3-8-9/AD
E2	SAM's Procedure Manual for Gathering Data Base, C.E. Technical Services (Sept. 1974)	1-2-5/A
E2	SAM Wastewater Collection System Analysis Model User's Manual, Wesley O'Neal, et al., (CH2M/Hill) (Apr. 1976)	1-2-5/A